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ABSTRACT

The incorporation of science and technology developments into a standard liberal arts core (the New Liberal Arts) is addressed in papers presented at six conferences and workshops held at various intervals during 1984 and 1985 at State University of New York campuses. The New Liberal Arts has been part of ongoing general education curriculum revision at SUNY campuses. Paper titles and authors are as follows: "Ars-Techne-Scientia: Integrity of Culture Needs Unity of Knowledge" (Lynton Keith Caldwell); "Panel on the Future of the New Liberal Arts in SUNY" (Humphrey Tonkin); "The Liberal Arts for Today and Tomorrow: 'An Action Plan for the New Liberal Arts'"(H. Tonkin); "Ethics and Values in Science and Technology: The Price of Success" (Charle O. Warren); "Why Science, Technology, and Society Courses Should be Society, Technology, and Science Courses; or Why Tails Shouldn't Wag Dogs" (Robert Keesey); "The Future of the 'New Liberal Arts' at SUNY" (James W. Hall); "The New Liberal Arts" (Selby Hickey); "New Jersey's Model for Stimulating Change" (Edward D. Goldberg); "New Liberal Arts" (Thomas Kurtz); "A New Liberal Arts Course on Decision Analysis" (Samuel Goldberg); and "The Impact of Technology on Art and Art on Technology: A College Course Design" (Julie H. Wosk). The SUNY Advisory Committee on the New Liberal Arts membership list and a list of the SUNY meetings on the New Liberal Arts are appended. (SW)

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The State University of New York

The New Liberal Arts — Curriculum in Transition

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INTRODUCTION

The New Liberal Arts and the State University of New York

In October 1983 the Alfred P. Sloan Foundation provided the State University of New York (SUNY) with a planning grant to promote activities in the New Liberal Arts. The New Liberal Arts is a curriculum concept which urges the incorporation of the implications of science and technology developments into a standard liberal arts core. The central concept is that the definition of an educated person, in terms of the liberal arts, must be expanded to incorporate an understanding of the effects of science and technology in our daily lives. Several institutions throughout the country have been heavily involved in developing the New Liberal Arts and have received Sloan Foundation grants to revise their undergraduate curricula accordingly. The idea of the New Liberal Arts has caught on substantially with the SUNY campuses and has been part of ongoing general education curriculum revision.

The major activities, as planned by the SUNY Advisory Committee on the New Liberal Arts (see list, p. 72), focused on statewide and regional meetings (see meeting schedule, p. 73) and on the development of a series of support activities and services. These included: the establishment of a central inventory of available documents and references, the production of a video film (created at one of the regional conferences and featuring a New Liberal Arts instructional practitioner), surveys of New Liberal Arts undertakings at the campuses involved in the project, plans for a New Liberal Arts newsletter to be instituted and maintained at SUC Potsdam, enhancement of the SUC Plattsburgh library data base, and faculty grants for course and curriculum development.

Most of the meetings offered general information and ideas about, and specific programmatic examples of, the inclusion of technology in liberal arts curricula. Several were directed toward informing participants about approaches to the broad issues.

In addition, a topically specific meeting was held at SUNY Albany at which specialized interests were emphasized in order to provide concrete examples to be used in teaching courses in the New Liberal Arts.

From these meetings we have selected certain key papers which discuss and elucidate the New Liberal Arts in both general and specific ways. Focusing upon the New Liberal Arts from a philosophical or broad viewpoint were: Lynton Keith Caldwell, Director of Advanced Studies in Science, Technology and Public Policy at Indiana University, at the workshop conducted at SUC Fredonia; Humphrey Tonkin, President of SUC Potsdam, at the Potsdam and Buffalo meetings; Charles O. Warren, Vice President of Academic Affairs at SUC Cortland, at the workshop held on that campus; Robert Keesey, Acting Director of the SUC Potsdam School Within the School program, at the Fredonia workshop; James W. Hall, President of Empire State College, at the first Albany conference; and Selby Hickey, Vice President of Academic Affairs at SUC Old Westbury, at the first Albany conference.

Those whose talks were of a more technical nature included Edward D. Goldberg, Assistant Chancellor for Academic Affairs, Department of Higher Education, State of New Jersey, at the Buffalo conference; Thomas E. Kurtz, Professor of Mathematics and Computing Sciences at Dartmouth College, at the first Albany conference; Dr. Samuel Goldberg, currently Program Officer of the Alfred P. Sloan Foundation but

at the time of the Albany conference, a Professor of Mathematics at Oberlin College; and Julie H. Wosk, Associate Professor of Humanities, SUNY Maritime College, at the Albany conference.

Caldwell's paper lays the groundwork for the others through a discussion of the manner in which "the unity of traditional culture has been disrupted by its inability to accommodate and incorporate the culture of science and science-based technology." He makes the point that an integrative approach to the disciplines in higher education "seeks to instill an appreciation of the interrelated and interactive character of knowledge as a way to foster a sense of responsibility in its application to human purposes..." and that "to assist development of a unifying or intellectually integrative educational experience, institutions of higher education will need to provide a basis for the rational consideration of values." One of the themes of Tonkin's paper is that "while technology is no monster in itself, it is up to us, as educators, to come to terms with it, to understand it, if we are to avoid perishing in its grip. We must, in short, work to develop what is good in it and to learn to contain what is evil and the necessary first step is faculty development and the creation of incentives to accomplish this development."

Tonkin, in his second paper, makes the point that "awareness of how technology has fostered a kind of interdependence in the world and has also sparked a struggle for access to the advantages of technology every bit as fierce as, and far more dangerous than, a similar struggle in 19th-century America, leads inevitably to an awareness of the importance of internationalism and above all to an awareness of the importance of educating our students to help build mechanisms, the institutions whereby peace can be preserved in a world where technology of war threatens to destroy us all." Warren focuses upon the idea that "due to the incredible scientific and technological advances which have occurred over the last four decades, the need to incorporate a solid system of ethics and values into the practice of science has become increasingly acute...and institutions must lead the way in educating for the discipline for action."

Keesey states "the mechanical cause and effect of many science, technology and society courses should be altered to see both science and technology as social processes, social artifacts that are both shaped by, as well as shapers of, the beliefs, values, necessities, desires, organization, and social relations of the cultures whose products they are." Hall's main point is that educators should "take steps that will increase the probability that truly imaginative teaching, which incorporates a powerful conceptual grasp of the integrative elements of knowledge and learning, can occur...more routinely." Hickey discusses the objective of the New Liberal Arts as being to revolutionize pedagogy to achieve unprecedented integration of the sciences, technology, the humanities and social sciences, and the necessary tasks in the achievement of this objective.

In the more technical group of papers, Edward Goldberg describes the initiatives towards higher education curriculum change taking place in New Jersey, with an emphasis upon technological literacy as a curricular outcome. Kurtz states that "the truly important purpose for incorporating computer use into the liberal arts is every bit as fundamental as high school algebra...as educators, we must meld computer skills with other vocational skills, such as writing and speaking, which have long been associated with the liberal arts." Samuel Goldberg discusses applied mathematics through the "demonstration of decision analysis, using the literature of business, social science and medicine." And finally, Wosk discusses a course on Art and Technology by illu-

minating areas where the "two cultures" interact and beneficially impact each other, examining cybernetic sculptures and the wide range of artworks reflecting the influence of technology.

Enhanced understanding of the nature of the New Liberal Arts and a grasp of the mechanisms by which it can become a reality on SUNY campuses as well as at other institutions are necessary precursors to the acceptance and adoption of the New Liberal Arts by faculty, administrators, and students. Through the publication and dissemination of these speeches, the State University of New York hopes to reach an even greater audience with the ideas that are brought forward and discussed in this booklet, thus to facilitate the curriculum change process within the SUNY campuses and elsewhere.

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March 1986

PART I —
THE NEW LIBERAL ARTS: AN OVERVIEW

Ars-Techne-Scientia — Integrity of Culture Needs Unity of Knowledge

by

Lynton Keith Caldwell

Knowledge is multi-dimensional and indefinitely expansible. Its facets, like sides of a cube or polyhedron, form in every culture a common unity. But the usefulness of this simile is limited, because knowledge is neither solid nor symmetrical. The nature of knowledge has been a major concern of philosophy; but in this essay the more formidable issues of epistemology will be evaded through regarding knowledge to be what is known or believed in any culture. The expression "unity of knowledge," however, should not be taken to imply completeness. Ignorance in varied degrees is common to all human cultures. "Blank spaces" in the configurations of knowledge may or may not be recognized in particular cultures; "mystery" signifying the incompleteness of knowledge. To the extent that humans identify areas where knowledge does not presently extend, this recognition of ignorance may in itself be regarded as a form of knowledge and is chiefly found where science has become a way of knowing.

Absence of some aspect of knowledge in a culture does not necessarily constitute conceptual disunity, but irreconcilable contradictions or anomalies in knowledge do. Wholly unified knowledge is hardly possible outside of isolated traditional cultures. Where science flourishes some disunity of knowledge is inevitable as new knowledge can seldom be reconciled immediately with what has previously been believed.

A problem arises, however, when two aspects of knowledge or knowing are incompatible and cannot logically coexist; the unity of knowledge is fractured. Disunity is not necessarily signified by knowledge that is known to be incomplete, if there is reason to believe that there are factors yet to be discovered that are consistent with those known to exist. The integrity or wholeness of a culture is dependent upon an interrelation of the various forms of knowledge available within that culture. The character, extent, and uses of knowledge must be congruent within a culture, since culture is the manifest expression of the realm within which knowledge is acquired, preserved, tested, dispensed, and applied. Today our culture is faced with the task of uniting technical and scientific knowledge with humanistic knowledge represented by the liberal arts. Let us concede that so long as knowledge expands, the sum total of knowledge can probably never be internally consistent. But the degree of fracturing within any realm of knowledge may be significant for the culture in which it exists.

Unified Knowledge Requires Many Ways of Knowing

In today's world, the greater risk is less often of ignorance than misapplied knowledge, although they sometimes are substantially the same thing. The power of knowl-

edge, as with all forms of power, is subject to excess and abuse. Knowledge applied through artifice and technique, and pursued toward insufficiently considered ends without regard for possible unintended consequences, can easily lead to unwilled results. The application of specialized information or capabilities, isolated from other forms of knowing, entails the risk of failure or of worsening conditions in novel ways, and may offset or qualify the successes illustrated by the history of science and technology. Without the art of judgement regarding the wise use of knowledge, technique, the art of knowing how, irresponsibly applied, can be as dangerous as an unguided missile. No act can be isolated from multiple consequences; the task of wise judgement is to determine, so far as possible, which acts and which outcomes are the more significant, and to evaluate their potential benefits and risks.

The *reliability* of scientific knowledge gives it power, but not purpose. Science does not extend beyond the limits of its particular way of knowing; it does not provide the principles or priorities that guide its application to broader human purpose. For those, one must turn to other forms of knowledge — to experience, ethics, and aesthetics, all of which are accessible through the arts. If we rely upon science to guide its own uses, we risk the error of *scientism,* a delusion that is dangerous because it appears to be grounded in valid knowledge. In fact, science, per se, has no resource to determine how it should be used toward purposes beyond its modes of analysis. Additionally, unguided technology or technique can lead to *technocracy,* or the dominance of means over ends. Doing the technically feasible can become an end in itself. Defense against this risk can be strengthened by integrating the study of science and technology with that of the liberal arts.

The ultimate task of the liberal arts is to enlarge the mind's capacity to make wise use of what is known. This may be done by interrelating knowledge with considered human experience to make intelligent choices in the uses of technique and the applications of science. And whereas education and research may focus on specific aspects of the arts, technology, or science, these aspects of knowledge must ultimately be interrelated to form a mutually corrective and consistent whole which of course includes room for unresolved problems and unanswered questions. A basic question facing educators today is not *whether* the arts, technology, and science should be brought together in the educational process, but *how* it should be done.

To regard the arts, technology, and the sciences as isolated from and antithetical to each other is to fall short of understanding the nature of each, and to misunderstand the meaning of human knowledge. Each of these aspects of knowledge has its distinctive characteristics, and although each may be separated in theory, they are ultimately inseparable in practice. These various ways of knowing are complexly interrelated in our culture, and are a comprehensive expression of the culture.

Unity of knowledge has been a continuing concern in Western philosophy, but the practical importance of the concept has often been discounted. The concept of unity may allow for differences, divergences, and even for resolvable contradictions within a common realm of information, experience, and understanding. Isolating one aspect of knowledge from another, to the extent that each aspect of knowledge is regarded as self-contained and inaccessible to the other, is inconsistent with the unity of knowledge or culture. Fractured knowledge disunifies culture. When the arts, technology, and science are present but mutually isolated within a society, the fractured corpus of knowledge may result in the formation of two or more incomplete cultures. In a society such as ours, which is facing both great opportunities and greater dangers, dis-

unity in knowledge presents a problem and a challenge which must concern educational leadership.

Knowledge is no more wholly contained within modern science than it is within the arts and technology. The sum total of knowledge is that imminent presence of information, methods of learning, and considered experience which continues and grows in the flow of historic time. Historically, knowledge develops within particular cultures, but it has always been transferable within and among cultures. People may learn from one another — but do not always do so. Some scholars have described knowledge as a distinctive realm of existence — the Noosphere — with an existence of its own beyond the lives of transitory individuals or generations.

The meanings of the antique terms ars, techne, and scientia used in the title, were, in their Greek and Latin context, much less specific and confusing than they are in their modern derivations. The enormous expansion and specialization of knowledge in modern times has led to a segregation and sharpening of the meaning of these terms. Modern Western culture distinguishes and even sharply differentiates art, technology, and science as separate aspects of knowledge. In classical culture *ars* and *techne* differed principally in their linguistic aspects; both denoted artifice, purposive design, discipline, and skill. Both were precursors of testable substantive *knowledge — scientia.*

In the past, science in the modern sense was not accessible to ordinary people. The different arts of trained observation and logical reasoning were practiced by small elites to construct coherent interpretations of the world and man's place in it, and when based upon valid information and done carefully, approximated the methods of science. These methods of disciplined thought are no less important in today's world, and occupy an intellectual borderland interrelating science and philosophy. The arts of learning, testing, and conjecture are foundations of knowledge upon which humans may more safely rely than upon intuition or speculation. The differentiation and separation of science from philosophy in the modern world may be largely explained by the exponential expansion of knowledge accompanied by a necessity for its specialization, a specialization abetted by advances in science-related technologies.

The advancement of modern techno-science has largely proceeded through the in-depth penetration of ever more closely defined areas of knowledge. The effort to understand phenomena by pursuing them to their most elemental aspects is known as "reductionism". The ends are other. It is well known that skill, experience, discipline, and informed judgement are important qualities in scientific investigation. They are, or represent, arts contributory to the advancement of science.

In summary, art, technology, and science are Protean aspects of a unified corpus of knowledge. They may be regarded as specific forms of knowledge but their significance cannot be fully understood without recognizing that each interacts with, and may even be transformed into, some element of the other. To regard these forms of knowledge as wholly separable is to deny the unity of knowledge and to discount important values inherent in a unified human culture.

Is Wisdom Possible?

The modern world's exuberant and insufficiently considered embrace of technology has induced an equally undisciplined anti-technology movement. This movement was begun early in the Industrial Revolution by the Luddites. As they found, and as their modern-day counterparts are finding, disaffection is not an effective antidote to technological excess, because it offers no way to separate the benefits of technology from

its risks. Anti-technologists thus appear to prefer the risks of incapacity to the risks of innovation.

In all human experience, no form of knowledge has probably ever been complete or wholly safe from misuse. Applications of knowledge have always been vulnerable to risks of uncertainty. Yet knowledge seems to generate its own imperatives; and so a major benefit of education could be to learn how to use knowledge in a world characterized by uncertainty. As humans seek to use knowledge purposefully, a collateral objective of reducing its attending risks becomes increasingly important. The greater the prospect that the applications of scientific knowledge will change circumstances, the more important it becomes to increase the probability that those circumstances will be the ones desired. Thus the abilities to foresee and forecast become important attributes of knowledge that has the power to obtain results.

It has been said that science, aided by technology, can show us how to obtain our goals, but that it cannot tell us what those goals should be. This statement is not wholly true, however, because although the evaluation of goals may be beyond the limits of scientific method, science may inform human choice by indicating the probable consequences of available alternatives. If the criteria for choice of human purposes remains primarily among the liberal arts and humanities, those choices may more wisely be made to the extent that they are more fully informed. The most reliable sources of factual information are those that are truly scientific.

Although science alone offers insufficient guidance toward human action, it may reveal the probable consequences of action taken or not taken and thereby afford a range of alternatives against which the evaluative capability of human cultures may be exercised. In making such choices, neither art, nor technology, nor science can be solely relied upon to produce desired results. Unilateral applications of the arts, technologies, and sciences have led, especially in our own time, to unilinear and too often destructive processes, which are conceptually disconnected from the other aspects of life upon which they have practical bearing. Such actions have resulted in a massive and irrational confusion of ends and means.

Policy makers on national and international levels now recognize the risks of miscarried knowledge and have sought for means to reduce the incidence of error. In scarcely more than two decades, science-based techniques such as technology assessment, environment impact analysis, and risk analysis have been adopted as tools of national policy making. Techniques of statistical analysis have provided a much older way of increasing the probabilities of successful, if not necessarily wise, choices. Development of these techniques, which were once innovations, offers evidence that social learning does not occur and may also support hope that the disintegration of culture, which some observers see as a threat to the future of society, may be avoided.

The argument that an integration of ways of knowing is important to the making of wise choices in the uses of knowledge assumes the possibility of knowing what choices will be wise rather than finding them wise only in retrospect. *Wisdom* is a concept that appears to have gone out of fashion; like *virtue* it sounds presumptuous to sophisticated moderns. Attitudes vaguely termed "cultural pluralism" and "ethical relativism" are widely prevalent today, and are seldom consistent with the idea of wisdom in any general sense. Wisdom is a normative concept and requires criteria to give it meaning, yet some results of human choices have been demonstrably better fc people and individuals than others. A search for wisdom implies a search for valid criteria for choice and would be aided by a unified rather than fragmented state of knowl-

edge. In view of the risks attending the uses of powerful technologies in today's world, the rehabilitation of wisdom as a meaningful concept may be overdue.

Fragmented Knowledge = Fragmented Culture

The threat to the integrity of modern culture appears to be real and self-generated. In historical retrospect, human cultures seem to have carried within them the agents of their own ultimate dissolution. The integrity of any culture is significantly conditioned by the state of knowledge coexisting with the culture. Thus, in the absence of contact with science or science-based technology, prescientific traditional cultures may be thoroughly integrated with their prevailing state of knowledge. Disintegration or transformation of indigenous cultures has characteristically followed the intrusion of Western European techno-scientific culture into the traditional societies of Asia, Africa, and the Americas.

Since the growth of science and science-based technology was at first an extension and outgrowth of the prevailing knowledge system of European society, Western culture was not threatened with displacement, but was nonetheless transformed. But the progressive growth of science and the failure of traditional culture, through its educational system, to integrate the new knowledge into the curriculum of the schools, led to a cultural fission which ultimately caused Sir Charles Percy Snow to conclude that, at least for Great Britain, two cultures coexisted, neither of which was fully intellectually accessible to the other.

Under the two culture thesis it is possible for some individuals to live in both cultures and to communicate with persons in each. But for others, the gap between the cultures is too wide to be bridged, and the persons in each are unable to comprehend the assumptions, values, and perspectives of those in the other. Under a two-culture thesis everyone is born into a traditional culture, but only some cross over into the culture of science, regarded as an overlay upon the traditional culture. The scientific "super-culture" may now be found in almost every country in the world: most notably in those countries most advanced in science and technology. The coexistence of these cultures has not always been harmonious. The scientific culture poses a continuing threat to traditionalism and, as seen in the overthrow of modernization in Iran by Islamic fundamentalists, may be rejected with violence. In the United States, conflict between the culture of science and the culture of tradition is evident in confrontations in the news media, legislative halls, the courts, and at voting booths.

However, the consequences of the separation of science from traditional culture may have a different interpretation. Instead of a two-culture fission, Western culture may suffer from passive alienation and disintegration within its milieu. Devitalization of the culture rather than conflict is the consequence. Science, because of its limitations, does not extend to all areas of human experience, and cannot become a fully developed culture. No one can live wholly in a scientific super-culture; even scientists must live part of their lives in traditional culture. But the unity of traditional culture has been disrupted by its inability to accommodate and incorporate the culture of science and science-based technology. Traditional nonscientific culture can no longer be the whole culture that once was possible when incompatible knowledge generated by the sciences was not present. Thus the thesis of two cultures can be understood as the failure of two partial or incomplete aspects of knowledge to synthesize, or reconcile, within a common culture.

Unlike science, which (in theory) may exist apart from traditional culture, technol-

ogy is largely inseparable from the culture in which it exists. The exceptions pertain chiefly to those technologies associated with advanced aspects of science. From prehistory to the present, technology has shaped cultures and may be regarded as a characteristic expression of the culture in which it exists, whether that of ancient China, medieval Europe, pre-Columbian America, or the United States today. In modern times the scope and power of technology has been vastly increased by its association with science. Human possibilities in almost every aspect of life have been enlarged and extended and this is particularly true in the recording and communication of knowledge. Technologies such as printing, photographic reproduction, and the recording of telecommunications have given material substance to the Noosphere concept. Information technologies have greatly increased possibilities for the expansion and dissemination of knowledge and have permitted a situation to develop in which the management of knowledge has become a major task, particularly because of its ever-growing volume and specialization. Science is a driving force behind this expansion and specialization, and is now the source of most of the technological innovation that makes this growth possible.

Because of the ubiquitous character of science-based technology, a two-culture circumstance cannot be sustained indefinitely. When traditional and scientific cultures have not been reconciled and no true synthesis has occurred between the two, social instability is likely. This instability is often exaggerated by ethnic, economic, and idealogical disunities. In countries like the United States, in which a substantial fusion of scientific and traditional culture has occurred, the problem is less one of social instability and more one of social choice among the options offered by techno-scientific advances. Nevertheless, religious fundamentalism, which is strong in many American communities, rejects science where it conflicts with revelation.

Folklore has long cautioned against the making of insufficiently considered wishes when it is possible that those wishes may come true. Science-based technology's success at achieving insufficiently considered objectives has too often resulted in unforeseen and undesired consequences. Analytic techniques, such as technology assessment, environmental impact analysis, and, to some extent, cost-benefit analysis have been sought as correctives to misapplied technologies. These processes are intended to discover and should disclose the consequences and implications of technological choices. Applied only as technique, however, they have no power to indicate what choices should be made.

Neither science nor technology provide the criteria or the standards for making social choices, although they may provide important information regarding the possible consequences of alternative choices. To determine priorities for the uses of science and technology, and to apply criteria and standards to choice among alternatives, one must turn to the liberal arts or humanities. The liberal arts and humanities prepare the human mind to make discriminating choices. And the power of science and science-based technology makes it ever more important that the choices be informed and adequately considered in relation to their possible consequences.

When domains of science and traditional culture are mutually exclusive, the risks of social choice based on incomplete and inadequate information are greatly increased. Thus, the integrative role of the broadly defined liberal arts — philosophy, history, literature, and the representational and performing arts — play a major role in human fate in the modern world. The need to integrate the disciplines in higher education does not disparage the proper and important role of each of the separate disciplines. Nor

should it suggest a particular philosophical or ideological framework for an integrative approach toward learning, although there are dogmatic ideologies inimical to the free flow of knowledge. An integrative approach does not impose predetermined cultural norms upon students. Rather, it seeks to instill an appreciation of the interrelated and interactive character of knowledge as a way to foster a sense of responsibility in its application to human purposes.

Over the years there have been critics who have declared that preparation for the responsible use of knowledge is a task by which educational institutions have successfully experimented with integrative curricula. None, however, have fundamentally changed the general character of higher education. Science continues to increase the power of knowledge and technology, but no comparable growth is apparent in the responsible use of knowledge to address the more critical problems of our times.

To assist development of a unifying or intellectually integrative educational experience, institutions of higher education will need to provide a basis for rational consideration of values. For those fundamental values necessary to hold societies together consensus is needed; but there can be a great diversity of secondary values consistent with cultural integration. Assistance toward understanding the relationship between values and knowledge should also be a function of secondary education in democratic societies where social value must be broadly shared in order to be implemented in public life. A broader understanding of the relationship between causes and consequences reduces the risks of misusing specialized knowledge or technique. For this reason, specialization in education is best acquired when preceded by an educational experience that helps unify knowledge and culture and is not subdivided into disciplinary compartments.

There is an interactive relationship between higher education and the larger society which allows significant changes to be instigated both inside and outside of academia. For two decades university curricula have tended toward greater technical-methodological specialization and concomitant fractionalization by special studies (e.g. focused on ethnicity, gender, and ideology). If this tendency persists, higher education may fracture society rather than contribute to a basis for social consensus by unifying various areas of knowledge and clarifying the conditions needed for their responsible use.

At present, it is not clear how higher education can redirect its present tendencies. Institutions do not easily reform themselves and colleges and universities are not notably self-critical. Philanthropic foundations have sometimes stimulated change — as with area studies in the 1950s. But foundations are as often inclined to follow fashions as to promote innovation and critical self-examination. Nevertheless, a partnership of academic leadership and external moral and financial support offers the most likely prospect of renewing and continuing the search for an integrative higher education. Surely the signs of the times confirm the growing need for such a development.

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Panel on the Future of the New Liberal Arts in SUNY

by

Humphrey Tonkin

We do not know, neither can we predict, the consequences of the new technology. Consider, for example, the computer. The closest parallel to the invention of the computer is probably the invention of printing. We may argue over what was cause and what was effect in the Renaissance, but there is no doubt that the invention of printing was accompanied by far-reaching changes in the way in which people organized themselves and their experience, and in the way in which scholarship was organized. The period of the invention and expansion of printing was accompanied by massive expansion in the apparatus of the State. In England, in the sixteenth century, the universities were bursting at the seams, as increasingly large numbers of young men came to acquire an education readying them for the civil service or preparing them to teach other people. They created around them a network of the written word, which in turn challenged the existing linguistic network of the church. The invention of printing, in effect, led to the creation of rival texts to the Latin *Bible*. It led to a secularization of literacy. This new linguistic network challenged the authority of the church and resulted in a reconceptualization of the role of religion in society. The Church of England was as much a Ministry of Communication as a place of ritual.

As literacy expanded, national languages were standardized, and in turn challenged Latin for command of the printing press. With larger markets at their disposal, publishers turned to national languages. The sixteenth century saw a massive linguistic revolution as German, Spanish, French, and English established themselves as literary languages, and as languages of culture, no longer distant provincial dialects of Latin sacred texts. Cristoforo Landino, working in Italy in the late fifteenth century, applied to Dante the techniques of explication previously reserved for the *Bible* and laid the groundwork for the birth of literary criticism. What was significant about the work of Aldus Manutius, the great publisher of classical texts, was not so much the "rediscovery" of Greek and Latin texts (which were not, for the most part, lost) but the fact of rendering them as portable books that could be read in Trondheim as well as Turin, in Rotterdam as well as Rome. Knowledge became portable and decentralized.

The spread of literacy made colonization possible, and the growth of the nation state, associated with printing and literacy, made it an historical imperative. As for scholarship, if we have a library at our disposal — now a personal, portable library — we have less need of memory. The ancient Egyptians had a story about the invention of writing. Its inventor appeared before the god Thoth, full of excitement. The god was displeased. "Your invention will destroy memory," he said. In reality, of course, writers, the printed book, the computer, these expand memory by allowing our

own storage capacity to expand into a virtually limitless landscape of texts and books and floppy discs and microchips. We are concerned with the management of memory.

The computer is, of course, only one part of the technological revolution of today. Over the past two centuries we have witnessed a massive expansion of the machine, as human beings have expanded their influence over material things just as the computer expands our influence over the things of the mind. This expansion of technology has brought amazing advances in our standard of living, life expectancy, mobility, opportunities for self-realization, and education.

It has also killed millions upon millions of people — in the factories of the eighteenth and nineteenth centuries, on the battlefields of two world wars and, increasingly, in the homes of non-combatants everywhere from Dresden to nameless places in Iraq or Afghanistan or Vietnam. It has created new disparities of wealth between the industrialized nations and the developing nations.

In Spenser's *Faerie Queene*, the Red Cross Knight, rather foolhardily, enters the cave of the monster, Error. His companion Una, realizing his plight, calls to him: "Strangle her, else she sure will strangle thee." While technology is no monster in itself, it is up to us, as educators, to come to terms with it, to understand it, if we are to avoid perishing in its grip. We must, in short, work to develop what is good in it and to learn to contain what is evil.

The Sloan Foundation has laid out for us the beginning of an agenda in this regard — an agenda which would put the study of technology, and the modes of thought that it has spawned, at the center of the educational enterprise. It would also encourage us to become familiar with the techniques of the sciences and of mathematical modeling, and to apply these techniques in other fields as well.

This effort is timely. For the most part, our attempts to teach the sciences to so-called non-scientists in college have been only marginally successful. The techniques of mathematics are regarded by most of us as slightly esoteric and slightly sinister. How can this change? First, we must be sure about why we want it to change, what kind of new synthesis we wish to achieve. It is essential that a new melding of science and technology on the one hand and the humanities on the other not simply lead to a dilution in the influence of the humanities. Currently, the great imperatives of education are, above all, gaining an understanding of the world of phenomena, the world of society and the world of the mind, and applying the lessons of each to building the institutions and creating the values that will allow us to survive and prosper. We can no longer afford to exclude values from the classroom. We can no longer afford to study phenomena or society or mind without recourse to values and without careful weighing of every lesson learned. This enterprise is, then, a two-way street.

We must begin with the faculty, providing them with opportunities to learn techniques associated with other fields. Faculty development can take many forms: special intensive seminars or courses, opportunities for formal and informal interaction across departmental lines, released time, summer programs. The aim in this effort should be to share our knowledge, to make it easier to apply a multiplicity of techniques to our chosen subject matter. Such an effort will not come cheaply. As it is, SUNY faculty spend too much of their time in classrooms, not enough in reading and self-improvement and study and conversation. We need a special effort to provide them with time. It is in the interests of the state to grant this time. How can our citizen function effectively in a technological society that they do not understand?

Out of this process should come a willingness to try new things in the classroom —

perhaps a few new courses, but mostly a change in the way in which the old courses are taught. We should look for an infusion of new techniques, of new methods, indeed, of new approaches to material which is, for the most part, familiar. We must develop systems of reward for such infusion — time off for course preparation, special recognition for the application of new knowledge in the classroom. We must encourage the linkage of courses across disciplines. If this is to happen, we must reduce departmental rivalries, and make it clear to our faculty that we shall not measure them by crude statistical measures, that we shall not seek out devious ways to deprive them of their jobs. We must offer intellectual as well as bureaucratic leadership and we must respond to leadership intellectually rather than bureaucratically. We must, in short, work to create confidence and security. Only by the creation of such an atmosphere can we persuade people to take intellectual risks. We must reform our appointments procedure to appoint and promote people with a breadth of interest, people who are willing to interact with others.

On the campus, we must do all that we can to promote conversation and dialogue on technology and its effects, with special programming, visiting speakers and the like. We must reinforce in our public utterances the importance of this dialogue. We must, of course, do what we can to provide the instruments of modern technology — computers above all — for the use of students and faculty. Our departments of computer science can assist us in teaching the techniques of computer usage, computer analysis and computer communication. They should teach teachers as well as students.

On the Potsdam campus, the School Within the School (SWS) may hold the key to a program of general education for all students at Potsdam. We are anxious to generalize the SWS experience to larger numbers of faculty members — to move them into the program and then back into the departments. We are anxious to reach more students than we currently reach through SWS, probably (and inevitably) in more conventional settings. We hope, also, to generate discussion of those issues that I mentioned earlier through a program of guest speakers and longer-term visits by experts and scholars. While we are wedded to no specific strategy for bringing the study of technology into the classroom, there is little doubt in my own mind that the faculty regards it as important and that there is strong conviction among my colleagues that we must not shrink from the teaching of values in the classroom. Indeed, most remarkable of all is how little convincing on these issues we need to do. We are ready to move. The question "why" is already answered. We are now embarked on answering the question "how." I suspect the same is true of many other campuses, and I know that many are embarked on the same search as we are.

Through it all, we must remember two things: First, we have been here before. No one could predict with any certainty the multifarious effects of the invention of printing. But it changed our entire social, political and economic organization. The industrial revolution created the means and the mindset of imperialism even as it made some of us free. But the specter that haunted the nineteenth century — of civilization in decay, of Ozymandias buried beneath the sands of Arabia — has been replaced today not by the threat of the destruction of our civilization but by the threat of the destruction of the very planet itself. With its bombs and its computers, ours is in every sense a terminal civilization. Let us use our terminals well.

The Liberal Arts for Today and Tomorrow
"An Action Plan for the New Liberal Arts"

by

Humphrey Tonkin

In his elegant and stimulating address this afternoon, President Sample described the development of American higher education and particularly the impact of modern scientific studies on the fabric of our educational system in the late nineteenth and early twentieth centuries. The arrival of science and the scientific method led, above all, to the development of graduate studies and the growth of the Ph.D. degree, and its roots lay particularly in the German universities. Yale University had flirted with the German academic system as early as the beginning of the nineteenth century and it was Yale, as well as such newer foundations as Johns Hopkins and Catholic University and other essentially graduate institutions, that helped to promote doctoral study in this country.

We are apt to believe that the growth of graduate studies somehow pushed the notion of a broad education in the liberal arts into second position. But this is only partially true. In reality, and in characteristic American fashion, we can define in nineteenth-century American higher education two separate traditions: the idea of the liberal arts, fostered at Eliot's Harvard and at dozens of small liberal arts colleges that grew up all across America in the nineteenth century (a development in higher education unique to this country) and second, the idea of specialization, associated with the growth of graduate schools, to be sure, but also, in a measure, with the growth of major programs at the undergraduate level. Perhaps a third institution needs to be mentioned here as well: the great state systems of higher education, which advanced the notion that higher education was potentially accessible to all, which built into teacher education certain of the ideas we associate with the liberal arts and which developed advanced programs to help provide the specialists needed for the rapid economic development, particularly of the Midwestern States. The liberal arts were rooted, in turn, in notions about the dependence of American democracy on an educated citizenry. Specialization was rooted in notions of economic prosperity. The two went hand in hand, and both were supported by the ideology of learning for its own sake, an idea which, in effect, legitimized higher education and, as it were, masked its highly functional institutional role in American politics and economics.

But my topic this evening has to do with the present and the future rather than the past. I want to raise with you the question of the future of the liberal arts in a country where specialization often seems to dominate education and the growth of knowledge seems to outstrip our ability to make sense of the world.

I must begin, though, with a couple of words of caution. First, on the matter of specialization. President Sample's lament for the lost generalist, his remark that there are

no historians, no literary scholars any more, only late nineteenth-century diplomatic historians or pre-1640 Miltonists, was in fact thoroughly belied by the breadth of his own knowledge. We all of us complain about the narrowness of our own specialities, and yet we all of us seem somehow to have acquired an education far broader than we are willing — intellectually willing — to admit to. Even as I made the statement that I had devoted half of my life to studying Spenser's *Faerie Queene,* I realized that the other half was given to a whole range of topics, leading, of course, to that summit of *docta ignorantia,* a college presidency. We are perhaps too quick to condemn our own educational system. Certainly the American system of higher education is the envy of the world.

We are also sometimes inclined to believe that the liberal arts sprang fully armed, if not from the head of Jupiter, then, at least, from the head of Minerva. In reality, the idea of the liberal arts is a homegrown American invention. It exists nowhere else in the world, except where the American professoriate has set its collective foot. Because the idea of the liberal arts lies at the very center of American undergraduate education, we should take it very seriously — it is firmly validated by our own cultural traditions, but it is not the only way of teaching young adults.

Since the time when the basic lineaments of the American system of liberal arts education emerged in the late nineteenth century, the world has changed. The system that came into being some hundred years ago was based on a set of assumptions about the education and growth of the individual and the preservation of democratic institutions in the United States. It was assumed, at least when the liberal arts curriculum crystallized in the twentieth century, that everyone should have an understanding of the basic branches of knowledge — humanities, social sciences, natural sciences. It was further assumed that everyone should be able to communicate effectively, have a basic knowledge of mathematics, understand the institutions of the United States, be adequately provided with a moral and ethical awareness. Also fundamental to this educational program was a deeper acquaintance with a particular discipline. The major insulated general education from practical concerns. As graduate and professional education grew in the twentieth century, the liberal arts became less and less linked with the acquisition of the skills needed to obtain and retain a job and to advance in one's chosen field.

The growth of graduate education affected education in the liberal arts in another way, too. As programs in the particular disciplines grew, so did the competition for resources. Increasing departmentalization set up what were, in effect, academic tariff barriers between departments. As these departments, in turn, began to produce their highly trained new professors and these professors were hired into the colleges, disciplinary loyalty became so strong that general education, liberal arts education, took second place to programs in the majors, even in colleges where the liberal arts had always been powerful.

Today, the old idea of the liberal arts is everywhere called into question. A broadening of the audience for higher education has brought into our colleges and universities so diverse a clientele, with such different agendas, and so many different exit points, that many are reluctant to accept the notion of the essential inutility of an undergraduate education — the belief that an undergraduate education is not intended for immediate, practical application, but is a preparation for life. Rising costs of tuition ha' fed this resistance, as people have looked for immediate returns on their investment in higher education. So have political developments, particularly in the 1960s and

1970s. Above all, the mixed feelings of academics themselves and the gap between their actions and their rhetoric (whereby they have neglected general education in favor of the disciplines), have brought about something of a crisis in the liberal arts — a crisis that many institutions across the country, including my own, are beginning to address.

While faculty members are raising many questions in this debate and some are seeking to turn the clock back, or somehow avenge what they see as backsliding of the 1960s and the 1970s, the principal question that they are asking themselves is this: Is general education responding effectively to the needs of students in the late twentieth century? They are asking this question partly because their clients, the students, are asking it (and this is a tight admissions market, in which we tend to pay attention to what our clients are saying), and partly because they are conscious of the fact that undergraduate education seems not to have kept pace with changes in the larger world.

One of the greatest of these changes has been in the relations among the various nations of the world. For the present audience, I need not rehearse the ways in which our world has become smaller, or more interdependent. In many respects, the year 1945 was the major turning point. This was a year in which four major events took place: the dropping of atomic bombs on Hiroshima and Nagasaki, the consequent ending of the Second World War and the defeat of Germany and Japan, the development of the computer, and the founding of the United Nations. One might equally well point to the invention of the jet engine, or the discovery of radar, or the creation of the transistor, which also took place in the 1940s. In any event, it was in these years that the basic elements in our system of defense and warfare, the main ingredients of our communications systems (both transportation and electronic communication), and the essentials of our current system of world order were laid down, for better or for worse. A second wave of changes, around 1960, accompanied the first. They included the launching of the first artificial satellite, the establishment of international jet airplane service on a regular basis, the creation of the hydrogen bomb, and the rapid move toward political independence by the newly emerging nations of the Third World.

The Bomb, particularly, changed everything. Not only did it suddenly threaten the very existence of the planet, but is also thrust on humankind a responsibility that it was ill-equipped to assume — the responsibility to keep the peace between the superpowers because everyone's existence was at stake. This, of course, did not lessen the mutual hostility of our fellow human beings. The death toll in local wars, including wars involving the United States and the Soviet Union, is as high or higher in an average year as it has ever been. Indeed, the principal result of the discovery of nuclear destruction seems to have been a massive diversion of energy and resources into the stockpiling of nuclear weapons, but certainly not an ending of conventional warfare. There have been well over 130 local wars since 1945. The First World War, you will recall, was described in the 1920s as a "war to end all wars." Neither it nor the Second World War ended wars; they simply changed them.

Today, the combined arsenals of the United States and the Soviet Union could destroy the human race 10, or perhaps 20, times over. When we talk about nuclear freezes or arms reductions, we should bear this in mind. Even a 90 percent reduction in weapons would still leave us about where we are now — with the entire human race at risk. Arms control negotiations are primarily economic negotiations — discussions about how the great powers are going to use their money. The nuclear threat is here to stay. It will not go away.

If terror brings us together, so does trade. If the fear of destruction unites us, so do

modern communications. We have witnessed, in the past several years, a revolution not only in warfare, but also in economics. No nation today can formulate its budget, or fix its economic policies, without regard to international economic forces. Such questions are now of primary importance. We have witnessed a revolution in agriculture, a revolution in medicine. These huge changes are of such far-reaching importance that they have changed the face of the earth, revolutionized human relationships, put new stresses and strains on the social order.

What we must recognize here is that the need to address a changed international environment is directly related to technological developments. It is technology that has produced the new internationalism, and it is the advance of science that has changed the shape of the world. That academic departmentalization that I referred to earlier was both the result of, and also the cause of, the development of new methodologies, and it brought about a concentration on the particulars of knowledge that made major scientific breakthroughs possible. Much of the progress of modern science has come about through sheer concentration of data and brainpower, stimulated, to be sure, by the spark of creativity. The great research facilities, the great graduate departments, are the devices used, the delivery system, as it were, for this awesome scientific power. It is one-half of our modern system of knowledge — specialization and concentration. The other half is, or ought to be, generalism. Let me illustrate what I mean by using a metaphor. One of the key devices of medieval warfare was the battering ram. The battering ram concentrates a great deal of force on a very small area. It can break through stout gates and solid walls. In the same way, the concentration of scientific knowledge can break through the stoutest of problems. But a battering ram does not build walls up again once it has passed, and it leaves a trail of destruction behind it. While its use may be very necessary, its use is also very limited. The skill that goes into making a battering ram is quite different from the skill needed to rebuild a city. And the more battering rams we have, the greater the need to rebuild. We can liken the battering ram, then, to the concentration of scientific knowledge on a particular problem, the kind of concentration represented, at the lowest level, by the ingredient of a major in an undergraduate curriculum. The rebuilding of the wall that it breaks through can be likened to the skills that we acquire through general education in the liberal arts. They involve, above all, the sensitive building of institutions, the reshaping of the fabric of our society to take into account new scientific discovery and fundamental technological changes. As the walls are broken down, we must rebuild them in new and newly enlightened ways.

Over the past 40 years or so, we have discovered, to our cost, that each new development in science, positive though it may be, leaves a trail of problems behind it. The so-called Green Revolution, for all its achievements, left the social fabric in many rural areas in a shambles, and higher crop yields undermined the local economy. Advances in medicine bring new problems of population control or create new economic strains. Industry brings pollution; new industry brings new types of pollution. Advances in communication create new concentrations of capital, new foci of political and economic control. As we lurch from scientific breakthrough to scientific breakthrough, we scramble to build institutions and to make laws to cope with them, and we struggle to redefine the changed landscape and, sadly, to benefit from it at the cost of our fellow human beings.

At the heart of the liberal arts is the notion of the unity of knowledge — that all that we understand of the universe of phenomena is linked to everything else. Also at the

heart of the liberal arts is a belief in the humane uses of knowledge — that all knowledge, all understanding, has its ethical dimension. Never before have such beliefs been as important as they are today. In effect, we are back at the beginning of the history of the liberal arts in American education, and we must once again make secure at the center of the educational enterprise the twin goals of the education and growth of the individual, and the preservation of democratic institutions.

I would argue, however, that in one important respect the imperatives have changed. A century or more ago, we were concerned with the development and prosperity of the United States, but now our concern must focus on the whole world. A century or more ago, one of the great issues facing the United States was how to balance the free development of the capitalist economy with the principles embodied in the Constitution. The past century has witnessed the gradual enfranchisement of new sections of the population — a process carried through not without struggle and even carnage. The industrial workers in the sweatshops of the nineteenth century, the migrant workers of 50 years ago, the disenfranchised blacks of 30 or 40 years ago — these are now participants in the American commonwealth. While we continue to have our massive problems at home, the modern equivalents of the works in the sweatshops, of the masses of unemployed, unskilled workers who were displaced and destroyed by advances in technology in the nineteenth century, are not to be found in the United States. They are the unnamed and unrecognized inhabitants of the Third World, struggling for a share in the world's wealth much as their brothers and sisters did in America a century ago. And if those brothers and sisters survived, they survived either because they found new opportunities in an expanding economy or because a haphazard and random system of charity helped to support them, much as we seek to come to grips with the tragedy of starvation in Ethiopia, Chad or Mauritania.

It was, I believe, more than coincidence that caused the civil rights movement to gather momentum in the United States at the same time as the independence movement burst forth in Africa and other parts of the world in the late 1950s and early 1960s. The rhetoric of the two movements was frequently similar, the one borrowing from the other, and something of the rhetoric of the civil rights movement is still recognizable in the language that the Third World uses today in the United Nations. What many of us regard as perhaps the final step in the enfranchisement of particular groups of Americans (and I speak here not of the relation between the sexes but of ethnic and socioeconomic communities) parallels an early stage in the process of emancipation on a worldwide scale. Were it not for advances in communications technology, and changes in the economic relationship between the former colonies and the colonial powers (changes produced, in turn, by technological developments), we would not be witnessing the shifts in the emancipation now, any more than we would have witnessed the shifts in the relationship between labor and capital that took place in nineteenth-century America.

We are attending this conference today, at least in part, because, a few years ago, an important paper was issued by the Sloan Foundation. It called on education to look for ways of working into the curriculum the new knowledge — above all the new methodologies — that have come into the disciplines in recent years. The paper gave particular attention to mathematical modeling. The foundation set up a program in what it called the New Liberal Arts to advance its purpose. As that program has since developed, it has tended to focus not so much on the techniques of mathematics as on the implications of technological change, and courses and programs under the auspices

of Sloan have grown up in a number of institutions to explore the relationship between scientific change and human society. Those involved in these activities have emphasized the need to infuse into the curriculum greater attention to the issues raised by technological change, as well as to create new programs and courses. In this respect, they have followed a similar direction to those who advocate the internationalization of the curriculum. The two concerns go hand in hand, and the two movements have paralleled one another.

One of the points emphasized by the advocates of the New Liberal Arts is the need to demythologize technology, to reduce it to manageable dimensions, by helping students to understand it. In international affairs, as in technology, it is irrational fears, ignorance, and lack of understanding that are the main enemies. If we are to manage our environment, we must be willing to deal with it. In short, we must teach our students what they need to know to cope with the new realities of the modern world. Above all, we must teach them how to deal with *lack* of knowledge. Let me explain what I mean.

An education in the liberal arts teaches us how to gather and analyze information from all available sources. Ideally, it acquaints us with the procedures for gathering information, it helps us to apply the methodologies of the various disciplines to the examination of that information, and it teaches us how to evaluate evidence. But fundamental to the idea of the liberal arts is that ultimately we, as ordinary citizens, must make judgments as best as we can about complex issues that we cannot possibly fully understand. Today's world is in many respects a world of specialists, but modern democratic society reserves for democratic institutions the right and the obligation to pass final judgment on the conclusions and the recommendations of these specialists. In this sense, the liberal arts not only teach us how to acquire all available evidence, but also, ideally, how to make decisions on the best information available, even when that information may be incomplete or not fully comprehensible. To this extent, the liberal arts are concerned not only with the wise management of knowledge but also with the management, or containment, of ignorance. In today's world, in which science leaps ahead from mountaintop to mountaintop and technology follows close behind, there is no imperative more important than the management and containment of ignorance. It is a task of huge and pressing urgency.

In this effort, much of the old ideology of the liberal arts can and should be revived. An understanding of the past, of our own roots, of science, of mathematics, of literature — all these things remain urgently important. But at one time they were used to teach us to be Americans. They were focused on western civilization, on the notion of creating a new and freer Europe in the wilderness of the New World. Today the whole world is our subject. The management of the world's economy and the preservation of peace require that we understand the relationships among cultures, the differences, those things that make us somehow distinctive. We must learn how to share the world's wealth equitably, but without tearing down its cultural and political framework in the process, and we must learn, unfortunately, how to live with fear, and how to deal with the fact of our own limitations.

As I see it, an awareness of how technology has fostered a kind of interdependence in the world and has also sparked a struggle for access to the advantages of technology every bit as fierce as, and far more dangerous than, a similar struggle in nineteenth century America, leads inevitably to an awareness of the importance of internationalism, and above all to an awareness of the importance of educating our students to help

build the mechanisms, the institutions, whereby peace can be preserved in a world where the technology of war threatens to destroy us all. Today, 40 years after the foundation of the United Nations, the forces of peace seem weak, indeed, but that is all the more reason for education, all the more reason for training generalists who can judge the specialists.

It is always well to end with some practical suggestions. Here are mine. Let those of us interested in a renovation of the liberal arts for the world of today and tomorrow:

- Teach ourselves and teach others about the importance of international studies and international understanding, building such matters into our own syllabi.
- Share our knowledge whenever and wherever we can.
- Show our colleagues the links between the traditional liberal arts and the new imperatives that surround us.
- Learn from one another.

Those of us who are educators should understand that the wise governance of this world of ours is directly related to the wisdom of the citizens of the United States and the ability of these citizens also to understand the obligations that go along with being citizens of the world. The United States is privileged to possess scientific knowledge and technological riches that make it the envy of the rest of the world. We need to learn the humility that goes with such wealth and to understand the manifestations of that envy. Particularly, we need to make our institutions of higher learning places in which our students, our citizens, can learn how to live wisely with complexity and how to manage and contain ignorance.

Ethics and Values in Science and Technology: the Price of Success

by

Charles O. Warren

Our age has discovered how to divorce knowledge from thought, with the result that we have, indeed, a science which is free, but hardly any science left which reflects. — Albert Schweitzer (1948)

Although recorded nearly four decades ago, Schweitzer's words are not an inappropriate description of the present state of science. Due to the incredible scientific and technological advances which have occurred over the last four decades, the need to incorporate a solid system of ethics and values into the practice of science has become increasingly acute. Tremendous social, political, economic, and moral problems have resulted from an increase in scientific and technical knowledge, forcing us to pay a price for our successes. We, as a nation, are confronted with moral and ethical questions whose answers could have far-reaching impacts, affecting not only our economy and political stability, but many lives. Consider, for example, the following scenarios:

- A 16-year-old high school sophomore lies in a hospital, in a deep coma, the victim of an auto crash! Breathing and circulation are being maintained artificially. A monitor reveals only the hint of vital brain waves. Should these extraordinary and costly means for sustaining life be removed? Should the medical team give up? Who decides?
- Molecular geneticists have developed the technology to recombine genetic information from very different species — the potential gains are great — so, perhaps are the risks. Should they proceed? Who decides?
- A single, young woman with a strong desire to become a mother elects to undergo artificial insemination by donor in a reputable, safe and licensed medical clinic. Is this morally permissible? What effects could this have on family, and thus societal, structure? Who decides?
- A group of prison inmates, all presumably incarcerated for life, have been asked to be experimental subjects for studies designed to test potentially valuable psychosurgical techniques or mood-altering drugs. Should they have been asked? Should the experiments proceed? Who decides?

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- A 15-year-old boy's abnormally aggressive behavior has reached the point of extreme destruction and danger — both at home and away. He has been expelled from school and institutionalization seems to be the only answer. The parents, however, hear of a new technology: *implanted electrodes connected to a nickel-size computer,* guaranteed to control aggressive behavior and allow social functioning. Should they try it? Who decides?

These are only a few realistic and poignant scenarios whose ethical problems pose grave and overwhelming dilemmas. These and similar situations occur every day, a result of what are often beneficial and much-needed technological advances. Intellectual excitement, an expansion of the human imagination, and pragmatic results are brought about by the same advances which create social, political, and economic problems. We cannot surrender to an hysterical evolution of scientific inquiry, but rather we must attend to the urgent need for sensitive, caring, incisive analyses and processes for partial resolution of the problems brought about by such inquiry. Already, in the past twenty years, there have been widespread ethical, humane, and moral responses to these issues. Various institutes, centers and societies, private and within the academy, have spearheaded such responses. The activities of such institutes fall into three principal categories: (1) research and analysis; (2) the influencing of public policy; and (3) education, formal and informal.

The Hastings Center Institute of Society, Ethics and the Life Sciences has been one of the most influential and effective of these bodies. Established in 1969 in Hastings-on-Hudson, New York, it has grown rapidly from a tiny cluster of thinkers — a few philosophers, a psychiatrist/lawyer and a scientist or two — into a dynamic worldwide organization with lay and professional membership and activity. The Hastings Center Report, a bi-monthly journal, and other publications of the Center have become invaluable to those intellectually involved in ethical concerns in science.

Other significant groups include the Joseph & Rose Kennedy Institute of Ethics — and within that, the Center for Bioethics — at Georgetown University; the Society for Values in Higher Education; the Northwest Institute of Ethics and the Life Sciences (Seattle); The Society for Health and Human Values (Philadelphia); and the Northwestern University Center for Ethics in the Professions. These are only a few such organizations, most of which were established after 1965.

The rapid growth in membership of these values-oriented groups has stimulated dramatic results on many fronts; in some instances, no doubt, lending momentum to embryonic activities already underway. The following are examples of the ramifications these groups' activities have had on a national scale:

- In 1975 a unique summer gathering, "International Institute on Health Care Ethics and Human Values," was held in Cincinnati. It brought together teachers, scientists, health practitioners, lay persons, the clergy, politicians and lawyers. In 1985, there will be dozens of similar events of regional, national, and international scale.
- Ethical review boards comprised of physicians, lay persons, clergy and philosophers, a rarity in 1970, are now commonplace in large hospitals and medical schools.

- Curricula in colleges and universities dealing with ethical issues in science and technology have grown rapidly (although, perhaps, inadequately) as has the quality and body of literature dealing with such topics.
- The writing and testimony of learned experts (ethicists, physicians, scientists, lawyers) from the academy and from institutes and centers, have had marked effects, although not always in a complementary fashion, on governmental, institutional, and industrial procedures and regulations.
- In what had heretofore been an unprecedented action, scientists policed scientists in the early 1970s and achieved a moratorium on recombinant-DNA research; additional results included intense local, state, and national legislative activity and the formation of a NIH Advisory Board, comprised of varied professionals and lay persons, that derived an initially stringent set of guidelines for the conduct of such research.

Dilemmas remain despite these and similar efforts. Encouragingly, the milieu from which moral reflection and reason might emerge grows more pluralistic, effective, and impressive daily. Yet much remains to be done, especially within the academy.

Before exploring the possible options available to those in academe who wish to confront the moral and ethical problems posed by science and technology, let's look outside our own country. Many other nations are undergoing a technological revolution which is as rapid as our own, and are plagued by similiar problems. Most are only slightly behind our own country in addressing these problems.

For example, Australia, sparked by the recent "frozen embryo" controversy, has moved from treating such subjects economically and legally to intensifying ethical debate, increasing the involvement of the federal government, and establishing a number of ethics and values centers.

Predictably, the trend in Britain has been towards pervasive public involvement, especially in the once cloistered halls of medicine and especially through the active intervention of television and the press. Attention also is being given to the need for medical ethics as an essential component of basic medical education.

Historically, in Yugoslavia, the principal bioethical concern has been equity. In more recent years, increased attention has been focused on ethical dilemmas dealing with cancer therapy, fetal medicine, and transplants. While government involvement remains minimal, universities are playing a major role, especially in the area of bioethics.

The Netherlands is another society where one observes a widespread interest in the debate of moral dilemmas, especially those associated with technological advances. Various groups attempt to develop unique ethical postures and the pressure for increased treatment of such issues in formal educational settings seems to be growing.

And finally, the National Consultative Committee on Ethics for the Life and Health Sciences has been formed in France and charged by President Francois Mitterand "to provide guidance on the moral problems raised by research in medicine and health." This committee is to deal with all associated questions and with all the various types of involved institutions and industries.

With national and international projects in mind, we can now focus on the present

and future roles of the academy in incorporating ethics and values in the practice and study of science and technology. In the case of the university, a question that supersedes the concern of *who* decides is *how* we decide. Or, how do we gain the necessary breadth and depth of insightful knowledge, technical and humanistic, to effectively understand and apply ethical theory to substantive dilemmas? How do we learn to approach such problems with a global awareness, with determination to retreat from hasty judgment, with a sophisticated ability to explicate thoroughly questions of rights and responsibilities and arrive at what one ought to do?

Self-serving though it may be, many of us fervently believe that liberal learning, within the academy and beyond its walls, is now more critical than ever. There has been a recent resurgence within the curriculum of courses in logic, in ethics (especially normative ethics), in science, society and technology. We are currently witnessing a revamping of general education requirements that are more conceptually-based and more values-oriented. Indeed, in SUNY and elsewhere, we are experiencing the new liberal arts. Presidents of prestigious colleges and universities are proudly proclaiming a renewed commitment to such educational endeavors.

Certainly, all of this is good. But it is not enough. It is not responsive enough for those of us who believe that the importance of wisdom, defined as the *knowledge of how to use knowledge for the social good,* has been too long dormant in our educational institutions — and especially in colleges of arts and sciences. Many, many institutions, especially universities, must revisit their general education programs with an eye towards educating for wisdom: "Wisdom," as Van Rensselaer Potter puts it, "is the discipline for action."

Departmental colleagues and administrators can facilitate such a process by fostering and valuing the efforts of those who create courses dealing with ethical dilemmas in science and technology. Such teachers should not be regarded as engaging in the "soft areas."

Scientists should be encouraged to continue their participation in courses aimed at enlightening the non-scientist within the ethical context. However, they should do so in more frequent conjunction with colleagues from the humanities and the social sciences. Additionally, they should welcome their own majors into such courses, while simultaneously introducing, in a natural fashion, ethical concerns into core courses with the major.

Administrators, too, can enhance the integration of ethics in the teaching of science and technology. Team teaching and exchange lectures between those with common interests and varying disciplinary perspectives must be encouraged and rewarded.

The social sciences, with isolated exceptions, are often notably absent in offering disciplinary perspective on such issues. Administrative supports must foster greater involvement from those areas.

The education of teachers, with the goal of enhancing the overall quality of education, is predicated on broader and greater substantive content leading to increased sophistication in reasoning and understanding in various value-laden areas. It is the special obligation of colleges specializing in teacher education to emphasize wisdom: the discipline for action.

With the college population changing from post-adolescents to adults, our educational mission in these and related areas must take new, creative forms aimed at not traditional students in nontraditional settings.

These are all formidable challenges. They are, however, attainable objectives, which

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are clearly within the context of our individual and collective professional identities. Progress is attested to by many of the national and international activities mentioned earlier. We now must accelerate our efforts. And, in the viewpoints of many, we should do so by attempting to construct philosophical and pragmatic umbrellas that would give form and focus to the myriad of efforts now occurring.

Hans Jonas expresses such thinking in a new book entitled, *The Imperative of Responsibility. In Search of an Ethics for the Technological Age.* He observes that "traditional ethics offers little guidance in solving the major survival problems of our time. . . ." This ethics was largely blind to scale effects, that is, to changes that take place with an increase in the numbers of interacting people. He adds, "all traditional ethics reckoned only with non-cumulative behavior." And he argues that now "ethics must be wedded to the science of ecology." Similarly, Van Rensselaer Potter envisions bioethics as a "bridge to the future" and calls for the establishment of a "Council on the Future," a broadly interdisciplinary group composed of "insiders" from various associations in the sciences and the humanities. The Council would be a fourth arm of government, with instructions to consider the consequences of major research programs and to recommend appropriate legislation to Congress.

Others choose to look at the formation of less powerful national commissions and "science courts" for guidance and advice. One senator has been proposing legislation to create a Science for Citizens program that would improve public understanding of public policy issues, encourage scientists, engineers and students to participate in activities aimed at the resolution of public policy issues, and enable nonprofit citizens' public interest groups to acquire greater scientific and technical expertise.

The dilemmas facing us in incorporating ethics and values in the study and practice of science and technology are many and complex, although there are already specific and general activities on many fronts with enormous implications. The roles of the academic — the teacher, the scholar, the interpreter — are clear and they are central. We must accept our roles and responsibilities directly and intensely.

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Why Science, Technology and Society Courses Should Be Society, Technology and Science Courses; or, Why Tails Shouldn't Wag Dogs

by

Robert Keesey

During the past decade, there has been an increasing debate about why and how science and technology components should become a larger and more integral part of general college curricula. The proposals take different directions and come from varying motivations; and although they usually overlap to one degree or another, there do seem to be some recognizable constituencies.

One, there is a strong economic/vocational impulse from those who seem to feel that without major changes in the teaching of science and technology our society will increasingly lose its leadership as the premier industrial power, and our students will be ill-equipped to compete in a rapidly changing world. Headlines in *The Chronicle of Higher Education* such as "France Invokes Memory of Diderot to Promote Technology" (4/18/84, p. 1) and "European Academy of Science Proposed to Spur Technological Competition" (9/26/84, p. 33) might indicate that our competitors share the same fears and offer the same panaceas.

A second group seems to feel that the academic world itself will fall fatally out of step if it does not increasingly incorporate new technologies in the classroom. Although "technologies" is usually pluralized, the only specific one I see much written about is the computer, and there the literature is saturated with applications for every field. From the information revolution to artificial intelligence, from word processing to mathematical modeling and simulation, everyone is encouraged to get into the act, ad nauseum. I am not anti-computer. I am, in fact, intrigued by its possibilities and its power. Any serious writer knows that the act of creating is actually rewriting, hence a word processor is a "creating" machine, whereas the typewriter is only a "fast and neat" machine. Unlike many people, I have very little idea of the magnitude of the computer's transformations of my world. Two things do strike me: (1) as in learning languages, one seriously learns them only when one realizes the need and I see little reason for institutions to push what has been, to a large extent, over-hyped; and (2) as in trying to understand their possible cultural impact, I am better off looking at the historical transformations wrought by other powerful technologies — printing, the factory system, electrification, etc.—rather than listening to contemporaries prophesy about the changes computers will effect.

A third constituency are those who argue that the dominant contemporary problems — all the environmental ones from resource depletion to pollution, biomedical/ethical ones, nuclear energy and weaponry, food production and distribu-

tion — have a scientific and technological dimension if not basis, and that without much greater "literacy" in these areas it is difficult for "citizens" to make rational choices. This absence of general scientific and technological knowledge continually increases public dependency on "experts," creating a "power elite" that unintentionally undermines the very foundations of democracy.

A last group, often also a part of the third, are those impelled by the belief or assumption that to understand ourselves as a contemporary industrial culture necessitates much more of an emphasis on the shaping factors of science and technology in our consciousness of history than we have traditionally included in the general curriculum.

It is mostly, I think, to the motives and rationales of the last two groups that Science, Technology and Society courses respond. The economic/vocational group would presumably be satisfied by a greater emphasis on more traditional mathematics and laboratory science courses and the introduction of a few "technological literacy" courses.

The wave of Science, Technology and Society courses that increasingly picked up force over the past two decades was an important attempt to incorporate into the curriculum both the growing recognition that our scientific and technological proficiency also had unforeseen consequences, and a quickly-developing historical consciousness of the inseparability of science and technology from our political, economic, social and moral dilemmas. My argument is not with the motivations, but with what has too often been the structure and underlying assumptions implied by the very word order of the general rubric of such courses: Science, Technology and Society.

The word order reflects what has been, until recently, a prevailing view that science provides objectively-derived as well as predictive knowledge of natural phenomena; and that the translation of that knowledge into the devices, tools and systems — the technologies — by which we transform energy and materials and life-forms to meet our needs, desires and ambitions has side effects and consequences that pose dilemmas and choices for society. The structure often goes something like this: "Here is what we know about the behavior of the atom, or whatever. As that knowledge is translated into reactors or bombs, there are these problems, glitches, consequences; how does, how will, how should society choose among conflicting needs, motives, claims, values?" Note — the same mechanical progression is implied in the often-used alternate title, "Science, Technology and Values:" knowledge, to instrumentality, to political, economic and moral choices.

Now this view of science as a disembodied producer and originator of objective knowledge that society can freely choose to draw upon in its fulfillment of needs and wants has certainly been trashed by just about everybody in the last decade or more. Stephen Jay Gould's words capture for me what I would argue is now the standard view among at least historians and philosophers of science:

> "I believe that science must be understood as a social phenomenon, a gutsy, human enterprise, not the work of robots programmed to collect pure information. I also present this view as an upbeat for science, not as a gloomy epitaph for a noble hope sacrificed on the altar of limitations. Science, since people must do it, is a socially-embedded activity. It progresses by hunch, vision and intuition. Much of its change through time does not record a closer approach to absolute truth, but the alteration of cultural contexts that in-

fluence it so strongly. Facts are not pure and unsullied bits of information; culture also influences what we see and how we see it. Theories, moreover, are not inexorable inductions from facts. The most creative theories are often imaginative visions imposed upon facts; the source of imagination is also strongly cultural." (*The Mismeasure of Man*, p. 22.)

I like Gould's statement of what by now has become almost a cliche, because he goes on to add an important caveat. He rejects the idea that because science is now seen as relative rather than objective and absolute, all knowledge is equally relative. There has been a recent tendency, I think, to play a variation on the old problematic, "if there is no God, then anything is lawful," with "if truth is relative, then all truths are equally relative," a position that seems to confuse objectivity and predictability. Gould goes on to say: "I do not ally myself with an overextension now popular in some historical circles: the purely relativistic claim that scientific change only reflects the modification of social contexts, that truth is a meaningless notion outside cultural assumptions, and that science can therefore provide no enduring answers. As a practicing scientist I share the credo of my colleagues: I believe that a factual reality exists and that science, though often in an obtuse and erratic manner, can learn about it."

While our changing views of the nature of science and its place as a social/cultural enterprise have been widely debated and publicized, our assumptions about the relationships between science and technology, and between society and technology, have undergone as significant, but less well-publicized, alterations.

First, historians like A. J. Bernal (*Science and Industry in the Nineteenth Century*) have argued that there was almost no relationship between science and technology until late in the Nineteenth Century, and for most of human history technology developed by using, by doing, by empirical trial and error, and that scientific inquiry was impelled more by technology than technology by science. Even historians like Arnold Pacey, who see more of an historical relationship between science and technology in areas like the "hydraulic engineering" of the Renaissance, take great pains to note that to "progress is to thread a maze, not to follow a straight highway." "As long as historians believed that science would only go forwards and that the direction of technical progress was always the same, they interpreted the researches and inventions of previous generations as a struggle to lay the foundations of our present technological achievement. Now it is more easily possible to see that the thinkers and inventors of the past were making quite different explorations from ours into technological possibility and that they were promoting quite different directions for technical progress, motivated by the social priorities of their own time," (*The Maze of Ingenuity*, p. 3). Derek de Solla Price, an historian of scientific instruments and the technology of experimental apparatus, has ventured that the scientific revolution itself, "as we call it, was largely the improvement and intention and use of a series of instruments or revelation that expanded the reach of science in innumerable directions, and almost fortuitously," ("Of Sealing Wax and String," *Natural History*, 1/84, p. 54).

Economic and technological historians of the modern world like Nathan Rosenberg, *Inside the Black Box*, David Hounshell, *From the American System to Mass Production 1800-1932*, David Noble, *America by Design*, et al, examining machines, processes, patent control, marketing strategies, and corporation and government records have altered many assumptions about such diverse technological problems as diffusion, change, transfer, how we learn, and what forces drive and are driven by tech-

nology. The old focus on invention and inventor, linear cause and effect has been replaced by notions that the great figures are part of the larger social and cultural milieu of their time, and that most change is incremental and indirect or multi-directional, and its causes are often multiple and glimpsed dimly. Lewis Mumford, Jacques Ellul, Langdon Winner, and others have presented powerful arguments for various levels of technological domination of both the modern self and industrial culture.

Now what all this totals up to is that the mechanical cause and effect structure of many Science, Technology and Society courses should be altered to see both science and technology as social processes, social artifacts that are both shaped by, as well as shapers of, the beliefs, values, necessities, desires, organization and social relations of the cultures whose products they are. All these aspects are not organized in some linear chain of being, but move through time and space (historical development) as a constantly altering web or network in which the transformation of one element is to change the relationships of all. To not change our ways of incorporating science and technology in the general curriculum in light of these shifts in historical perception is kin to claiming that tails wag dog because that is what one might see with the naked eye; and the problem with this is that it is bad science once one has a conception that, though invisible to surface perception, the other end may be the motivating force, or at least that both ends are inseparable parts of a dynamic whole.

We rightly chucked the old Western Civilization courses because they usually failed to incorporate the technological and scientific advances that altered both the natural and social worlds. Hence, the discussions of political and intellectual changes that were focused on were often sterile and lifeless sequences without the student having any idea of the level of material culture that the debates and power struggles were all about. I sometimes get the feeling that many Science, Technology, and Society courses suffer from the opposite defect.

My hope is that the New Liberal Arts will fuse both via interdisciplinary general education courses organized around the historical development of a society, a culture, an epoch, or even an artifact or an innovation or a process: the main criteria are interrelatedness and an intellectual rigor in attempting to understand the implications for society and nature of our knowledge, beliefs and actions.

The Future of the "New Liberal Arts" at SUNY

by

James W. Hall

The most important matter to be addressed by the new liberal arts project is this: "How can we elevate the probability that truly imaginative teaching, which incorporates a powerful conceptual grasp of the integrative elements of knowledge and learning, occurs more routinely across the University? Concomitantly, how can we increase the number of students who will experience inspiring and creative teaching during their undergraduate education at SUNY?" The solution to both of these questions lies within the new liberal arts program; we must expand and alter our perception, and our students' perceptions, of the liberal arts. We must incorporate traditional and non-traditional disciplines and practices into the new liberal arts.

In establishing a modern view of the liberal arts, a view approached with a knowledge of technology, a unification of the old and the new must occur in order to bring contemporary conceptual unity to our timeless but contextually wandering liberal arts. This unity is similar to the integration of architectural styles visible on the streets of Paris. A visitor strolling down a Parisian boulevard will see marvelous Gothic and Classic architecture and, further down the street, examples of Empire and Seicento architecture. Looming around a corner, and at first looking very much out of place, one comes upon the spectacular Centre George Pompidou. All of the building's functional aparati are structurally exposed — tubular protrusions, funnels, and escalators project outward from a variety of angles. At first appearance, they clash violently with the many older architectural styles. Once inside the Pompidou Center's jarring technostructure, however, there is a surprising reversal of one's visual orientation. Through the glass and the steel of this Parisian eyeball, the antique and the contemporary seem to become one. The more traditional structures, seen through this angular symbol of contemporary technology, become part of a more unified vision of the Parisian cityscape.

We must achieve a similar unity between technology, science, and the traditional liberal arts, combining the new with the old. In approaching the new liberal arts the choice of lens is critical. All too often our vision of the liberal arts has used a lens which does not permit us to see the important images and concepts offered by science and technology.

Once we, as educators, focus on the new view of the liberal arts, we must convince our students to do the same. This can be achieved in practical, rather than theoretical, terms if we remember that the center of any effective and coherent liberal arts program is academic advisement. Academic advisement is, of course, a familiar function. Every college claims to do it, but all evidence shows that few do it very well. Truly useful

academic advisement means student and faculty *academic planning;* i.e. planning which takes the student's educational goals seriously and which, through dialogue with a teacher/advisor, allows the student to gain an increasingly sophisticated grasp of what, how, and why particular curricular choices are made. In this way, academic advisement can be transformed into academic planning — it can become a significant force for motivating student learning.

Empire State College has long employed academic advisement as an integral tool for helping students to both plan and understand the educational process. An instance of the successful use of academic advisement can be seen in the experiences of one student. Greta came to Empire State College and asked to develop a degree program around her main interest and craft, weaving. She hadn't previously pursued this vocational/technical study because she felt that the predetermined and, at least for her, inexplicable requirements of the typical liberal arts curriculum hampered her interests. She saw little reason for the potpourri of Western Civilization, Freshman composition, calculus, physical education, and social science courses which were required by most traditional liberal arts colleges. Greta feared that those required courses, supposedly integrative in purpose, would leave her no time to weave. The traditionally structured academic program, she thought, began by rejecting her very reasons for attending college.

Capitalizing on her need to better understand her weaving, she designed a curriculum which evolved logically toward a series of related subjects. She spent a lot of time weaving and mastering new weaving techniques, but she also became fascinated with the structure of different textile fibers. In a surprisingly short time this interest diverged into other paths. The first concerned technological aspects of the weaving process. She researched the structure of looms and the invention of the flying shuttle during the industrial revolution. Later, a second path led to a comparative study of natural and synthetic fibers and their chemical and other physical attributes. Once Greta had completed these technological and scientific studies, she developed an interest in textile design and soon was studying Medieval tapestries. She pursued Medieval art, did a paper on the Bayeaux Tapestries, and later completed an independent project on the philosophy of aesthetics. Her proficiency in weaving so increased during this whole process that some of her own work was sold as art, art with a particular commercial value. Toward the end of her study, she broadened her own pedagogic competency so that she could work with others, using her weaving as a medium for therapy and teaching.

This alternative and evolutionary (or revolutionary?) advisement approach allowed Greta, a so-called vocational student, to build a curriculum around her educational needs and interest. At the start of her study, the faculty advisor could not have known which avenues of inquiry would interest Greta; only weaving was a certainty. Greta's final curriculum design evolved out her specific vocational and technical interests while fulfilling many of the best characteristics of an undergraduate liberal arts curriculum. Greta's curriculum was neither narrowly vocational, nor was it purely academic. It combined both liberal arts and vocational/technology learning, and cultivated the intellectual and personal competencies central to baccalaureate education. Her study at Empire State College related the weaver's spontaneous interest in one specific substantive area to an ever enlarging world that came to include science, technology, history, aesthetics, and pedagogy. Moreover, her training as an occupational therapist and her success as a practicing artist linked study and work.

The major question regarding the new liberal arts is not whether we wish to establish them in our educational system — as we can see from Greta's experience they are already here. Rather, the question is how we will integrate them within the system. At the core of our educational system are the faculty. SUNY now employs a generation of faculty professionals who are brilliantly specialized, but who, in many cases, lack even the basic conceptual understanding necessary to teach or advise students to relate science and technology to the other liberal arts. To address this problem, SUNY must sponsor a series of university-wide master seminars for faculty development of integrative teaching. These should be followed by a series of local campus seminars. The follow-up seminars are critically important for wide-spread faculty involvement, since they introduce faculty and academic administrators to the history of science and technology. This introduction would permit a better view of the evolution of our common humanity while allowing us to view philosophy, economics, and sociology through the lens of our developing technological world.

Many of our future students, and most of the students who now transfer from a community college, will seek study in some technological field. This choice is becoming more and more common and it will become much more so. While these students are very versatile in the use of the computer, most of our faculty, growing up in a computer-deprived age, do not have training in computer usage.

Many even resist gaining the hands-on experience which would provide them with a better understanding of the computer's personal and institutional impact. Most of us now teaching are computer illiterates. To address the problem, SUNY must sponsor a series of computer literacy workshops; hands-on demonstrations which will help to overcome the computer literacy gap between faculty and students.

But such activity, however necessary, is only a first step. In the recent book, *High School*, Ernest L. Boyer states that our first priority in bridging this gap ought to be to teach all students about the technological revolution of which computers are a part. He emphasizes that hands-on experience with the computer should not be the primary goal. Instead, the main goal should be to assure that students and teachers learn about the social impact technology has played and will play in their lives.

As discussed earlier, academic advisement has long been considered the stepchild of the whole liberal arts process. It needs to be accorded a new and central place in the undergraduate program. This change is more radical than it may at first appear, but it is crucial if our efforts at academic improvement and the new liberal arts are to have any chance of success. Many excellent SUNY programs have long attempted to solve this problem by linking science and technology to the liberal arts. Unfortunately, such programs are limited to a handful of students on any given campus at any given time. The process of academic advisement and planning must therefore become a conscious pedagogy linking the individual student to all of the courses offered by a college, and it must do this in a thoughtful, evolutionary, and ultimately coherent way.

The last several years have been times of great fiscal stringency. In the face of such difficulty, the University still retains a tremendous vitality with which to respond to important issues — the great talent and unlimited creativity of its faculty and staff. With proper leadership, stimulation, and support, this talent can be unleashed and used to address the kinds of issues that presently surround the new liberal arts.

The New Liberal Arts

by

Selby Hickey

The colloquium on "Science, Technology and the New liberal Arts" has answered, implicitly at least, one of the most interesting questions about such a gathering; "Why are we here?" Given the multiplicity of purposes currently served by higher education, we could have been convened to address shortages in the production of skilled technicians required for the American economy at the turn of the century, or we might have been brought together because of reports from our liberal arts graduates about the new competitive pressures of the marketplace into which we have tended to drop them with minimal attention to the condition of their parachutes. It cannot be said that these concerns had no place in our thinking and conversations, but it is worth noting, with some gratitude, that the evident purpose of our gathering has been different — it concerns education for an informed citizenship and cultivation of the capacity for mature responses to change.

What has really been concerning us these past two days is the "state of mind" we should seek to nourish in those we presume to educate. This is really the toughest — and probably the most rewarding — of all our objectives, both for teachers and for students. And it is, after all, what is meant by the concept of liberal arts.

The major addresses to this colloquium have provided examples of the ways in which the tools and insights of mathematics and the technologies can be made part of the education of students who are not pursuing specializations in these areas. That is, however, but half of our task. There is the other side of the coin; the integration of the perspectives of the humanities and the social sciences into the education of students who will pursue careers in the applied sciences.

What this colloquium has done for me is to underscore the importance to the tasks ahead of integrated teaching and learning — something we have often called (for lack of a more elegant label) the interdisciplinary approach. This is not, as it may be in danger of appearing, an obvious point, for the most common solution to the problem of educating for a "state of mind" is the distribution requirement — a device which by its very nature signals our cynicism and despair about the notion of integration. (If the teachers cannot or will not provide an example of the integrated mind, what on earth could lead us to believe that the students will be inclined to fill that vacuum?)

What might SUNY do? There is, of course, the easy solution (easy at least from an academic point of view if not a fiscal one): (a) ensure that all campuses achieve the remarkable density and accessibility of microcomputers that Dartmouth has attained; and (b) encourage or even mandate the principle that all undergraduate degree programs contain a requirement in computational skills. I will hazard the prediction that

these will be realities in SUNY in the year 2000, with or without special efforts to direct or inspire "the new liberal arts." A third ingredient — possible, but perhaps less persuasive with both legislators and educators — would be a degree requirement in ethics tailored to individual disciplines.

We are not participating in this colloquium because of an interest in easy solutions. Our objective, let us underline it, is to revolutionize pedagogy, to achieve an unprecedented integration of the sciences, technology, the humanities and the social sciences. It must be obvious to all of us who work in the academy that pedagogy is the dimension of our institutional life least susceptible to mandated change. Change of this kind by mandate is not only subversive to academic freedom, it is decidedly impractical, if for no other reason than because the objective of integrated teaching and learning runs counter to the powerful reward structures of the scholarly professions. It would also be counterproductive, for it would necessarily put on the defensive those whose conviction, enthusiasm and spontaneity are essential for success in the classroom. No, if there is to be significant change in pedagogy, if science, technology, the humanities and the social sciences are to be integrated into a "new liberal arts," it must be the result of percolation and seepage, the capillary action of enlivening ideas.

What this colloquium suggests to me is that there is in fact a wide range of interdisciplinary activities and projects SUNY could promote or establish which could have the effect of enriching curricula and embellishing pedagogy. Faculty could be provided with appropriate opportunities and inducements to focus on key tasks related to teaching the new liberal arts, tasks such as:

- The conceptualization of new formats for general education courses that would engage students in thinking about the interrelationship of different subjects of inquiry, the implications of methods, disciplines, and choices in human experience, and the modes of analysis and problem-solving that can contribute to the making of choices that are both conscious and informed.
- The design of new models for syllabi so that the thinking which leads an instructor to choice of topics, problems and assignments is made explicit, and that the syllabi itself can become a vehicle for the communication of pedagogical insights and raising of pedagogical issues.
- The creation of new course-related tasks and modes of evaluation that by their nature give the student an experience with "integrated" thinking.

To work towards these ends, SUNY might establish an Institute for the Teaching of the New Liberal Arts with a branch in each region, each with a paid director and an advisory board drawn from the faculty and administrations of regional campuses. These regional institutes could be funded to promote faculty exchanges, conversations across the disciplines, visiting lecturer programs, and summer faculty seminars (perhaps on the N.E.H. model). In each region, the activities of each year could be designed to reflect more or less on one theme or issue chosen by the regional advisory board. Opportunities could be provided for the regional advisory boards to meet together periodically to exchange progress reports and ideas for future activities.

The long-term work of irrigating and fertilizing a pedagogy for the new liberal arts could be supplemented by more formal rewards of which, as we all know, there are too

few for brilliance of achievement in pedagogy. There could be, for instance, an annual competition, with generous monetary awards, for the most impressive achievements in course design for the new liberal arts. The winning examples could be published by the State University Press. SUNY could sponsor an annual event designed to honor current recipients of the awards, to which all previous winners would be invited. This occasion could serve as the arena for a series of lectures by a distinguished guest, which it could be SUNY's objective to establish as one of the major endowed lecture series in the U.S. These and other similar projects might appropriately be administered by a SUNY-wide central office of the Institute for the Teaching of the New Liberal Arts.

Finally, SUNY might pay some attention to the preparation of college teachers. An emphasis on scholarship in doctoral programs is certainly justified, and not only because this is a way of sustaining disciplines and advancing inquiry, but also because scholarship is essential if teaching careers are to remain robust over the long haul. But doctoral programs are also the training ground for those who end up in college and university teaching, and therefore require some reexamination if pedagogy is to be revolutionized in service to a new liberal arts.

In the last analysis, the real question for SUNY is how ambitious the university is prepared to be. Paradoxically, the most cosmic of intentions would be to work changes at a microscopic level — the classroom. This is, I think, what the colloquium has helped us to see. No doubt it is a task for more than one generation. But dare we settle for less?

PART II —
THE NEW LIBERAL ARTS IN ACTION

New Jersey's Model for Stimulating Change

by

Edward D. Goldberg

I am pleased to be here today. Your program is an exciting one. This type of conference serves a worthwhile purpose through increasing dialogue about emerging educational thought.

This is an era in which calls for higher education change abound. Whether the calls come from such national reports as NIE's report on "Involvement in Learning" or from the self-searching of each institution of higher education, the calls are worthy of serious attention.

We are fortunate to be working in higher education today despite the negative consequences which have come to some institutions because of the drop in the traditional college age cohort. Such demographics force us to reflect, change and improve. It is clearly a period in which we can attempt dramatic reconfigurations of structure and curriculum because we are not preoccupied with pressure to respond to rising enrollments. We are, across the nation, heightening our ability to measure outcomes and to change. All of this is good. The first step towards institutional health and excellence is to recognize that, no matter how good things are, there is still much which needs to be done.

Today, I would like to share some thoughts with you on the topic: "New Jersey's Model for Stimulating Curriculum Change." My remarks reflect some of New Jersey's accomplishments which have been significant to us and of which we are proud.

In my talk, I hope to do the following:

First, I would like to describe the environment which has led to the New Jersey State Department of Higher Education being able to facilitate programmatic change at our colleges.

Second, I would like to describe the general model the Department of Higher Education uses to stimulate curriculum change.

Third, I would like to describe our full range of curriculum-oriented initiatives as background for what we did to support "The New Liberal Arts," the specific focus of your conference.

Fourth, I would like to describe some Department of Higher Education Program initiatives related to "The New Liberal Arts."

Fifth, I would like to summarize some lessons we have learned from our efforts.

Finally, I would like to describe factors which will lead to the "New Liberal Arts" being of even more importance in the future.

As stated, my first goal is to provide you with some understanding of the environment of our state. This background, I hope, will allow you to draw some conclusion

as to whether what we have done can serve as a model for you in the context of your situation.

I begin with a series of brief descriptions of factors affecting higher education in New Jersey. These include: the functions of the New Jersey State Board of Higher Education; the functions of the Department of Higher Education; the nature and number of higher education institutions; the level of state support for higher education; our Governor's and Legislature's stances towards higher education; our state's budgeting approach; and our state's economic health.

The New Jersey Board of Higher Education is relatively new; it is only 20 years old. It is not a governing board, but a coordinating board composed of nine public members and seven members representing institutions of higher education. It is a board which truly conducts its business in public session and actively engages in dialogue about critical higher education issues. Given the public member/institutional member mix, a wide diversity of views is expressed. It is pleasing to note, however, that new observers of the Board's dynamics frequently have difficulty discerning who is representing the "public" and who is representing "institutional interests." Consensus is usually reached.

Colleges have their own governing boards which are subject to the State Board's authority to varying extents depending on type of institution. The State Board's major statutory functions include: broad planning and policy setting; licensing of colleges and universities; approval of branch campuses and extension centers; approval of new degree programs; and — most importantly — the submission of a unified budget request to the Governor. This budget request is for all of higher education in the state, both public and independent colleges.

Indeed, one of the most critical sources of influence that the Board and the Department have is based upon the statutory monopoly of submitting a unified budget request. This is done after careful review of institutional budget submissions and hearings with colleges and groups of colleges. The budget process stimulates a great deal of reflection and planning; a great deal of future-oriented thinking. Our Board's finest accomplishment each year, in my opinion, is its carefully constructed budget recommendation. This budget request is always geared towards a quest for excellence and a desire to continue to foster access.

I mentioned before that the Board does not govern, but that it coordinates. In like manner, the Department sees itself not so much as a regulating body, but more so than ever as a catalytic agent. There has been a move away from regulation and toward the provision of broad technical assistance to our colleges.

The primary arm of the Department responsible for this technical assistance is the academic affairs area. It consists of ten offices; four of which deal with particular types of institutions — for example, we have an "Office of State Colleges" — and six of which deal with programmatic issues — for example, an "Office of Teacher Education." The programmatic offices are relatively new and have been created primarily because of our shift away from regulation. Further, we have an Office of Special Academic Projects which handles a variety of projects which don't neatly fall elsewhere, and the academic affairs area coordinates its efforts closely with the work of another part of the Department, which has primary responsibility for our complex, multi-site medical and dental university.

The distribution of institutions of higher education we have in New Jersey is as follows: there are 19 community colleges, nine state colleges, a state university with three

campuses, one technological university, 16 independent colleges, eight theological colleges, one proprietary institution licensed to offer degrees, and a multi-site medical and dental university.

To judge the size of our higher education enterprise, total state support this fiscal year is approximately $845 million. Of that amount, approximately $675 million goes for institutional support; approximately $70 million for student assistance; approximately $70 million for capital and debt service; and approximately $30 million for the Department, including our programs to help institutions improve and change their curricula.

In addition to understanding the nature of our Board, the importance of its carefully crafted budget, the Department's move towards technical assistance, the structure of higher education in the state, and the level of state support, you need to know how fortunate we have been for the past four years to have had an "education" Governor.

Governor Kean's background as an educator, having taught at both the secondary and higher education levels, as well as his overall personal orientation and commitment, contribute to the fact that the improvement of higher education is among his top priorities.

To illustrate, let me quote from his most recent *State of the State Message*. The Governor said:

> "The challenge is to achieve the goal which we have set for ourselves and which the public wants us to meet — to make New Jersey's system of higher education one of the best in the nation."

To further illustrate his orientation, I quote from Governor Kean's address to the Education Commission of the States — of which he is Chair — as he looks at the national higher education scene:

> "We have the best higher education system in the world, but the best is no longer sufficient, not because it has declined, but because our needs for it have expanded so dramatically. From the perspective of where we should be as a nation, a higher education system doing more of the same is not enough."

Not only have we been extraordinarily pleased with the Governor's general support and orientation, but also with his specific comments about particular issues of interest to us. For example, in regard to technological literacy, in his January 1984 *State of the State Message* he cited the challenge to ". . . increase the technological literacy of all our citizens so that they may understand . . . the technological changes that are occurring in our society."

Another important factor for you to know is that complementing the Governor's strong leadership, the Department has enjoyed strong legislative support; guaranteeing the health of higher education in New Jersey is a bipartisan matter. People in the Governor's Office and Legislators listen attentively.

Beyond a keen understanding of higher education's importance, there has been an important technical budgeting change introduced by Governor Kean and his Office of Management and Budget during the first year of his administration. This has been the move to what we call "Base Budgeting/Plus" — a move away from enrollment-driven formulas and incrementalism.

This has improved the ability of higher education to compete with other state activi-

ties. This "Base Budgeting/Plus" approach in effect says: "Your base is guaranteed, but there will be no additional dollars based on standard formulas of an inflation factor. You develop your vision, then your plans, and then your programs. Submit the best of those to the State Office of Management and Budget and the Governor's Office. Your programs will be judged against one another and against programs submitted by other state agencies and state-supported organizations. The best ideas which meet state goals will be funded."

In the ensuing competition of visions, plans, and programs, higher education has done well. The Department of Higher Education has been able to increase dramatically the funds it gets, which eventually flow to help our institutions — funds which are beyond those which our institutions would have been able to get directly in their institutional budgets.

Money in institutional budgets is more flexible money for our colleges — money in the Department's budget is targeted money. However, because the pie has expanded, there has been little department/institution tension over the amount of funds flowing to the Department. In fact, there is good support for the funding going to the Department.

Finally, to understand the state environment within which higher education functions, let me note that the economic health of the state has helped make possible strong budget commitments to higher education. We have had large increases in state revenue due to a vigorous economy. New Jersey has had very low unemployment, construction all around the state, and a strong across-the-board increase in business activity. We outpace most national averages.

Having discussed some broad and general factors to give you an appropriate context before I talk about the Department's catalytic role in curriculum change, you still need to know a little more about New Jersey. Let's, therefore, take a specific look at higher education in New Jersey four years ago:

- There were early warning signs of declining enrollment.
- There was an awareness that although declining enrollments would bring problems, this would also allow us to focus on the challenges and opportunities which could lead to healthy, positive curriculum change.
- There was a renewed interest in science and technology which led to the formation of the Governor's Commission on Science and Technology. This Commission studied how economic development could be stimulated by a number of methods, including the enhancement of the capabilities of our research-oriented institutions in a number of specific fields. Although the Commission's excellent work was primarily oriented towards research, a task force did deal with the need for human resources in a more technological world. This task force's report contained many insights which were used in our Department's planning effort.
- Finally, there was the issuance of a new *Statewide Plan for Higher Education* which provided overall direction for higher education in New Jersey.

  The master plan reaffirmed the twin goals of *excellence* and

access as the overall goals of higher education in the state. Specifically, it reaffirmed the goal of *excellence* through its call for the regular review of existing degree programs, and through its call for improvement.

Flowing from the master plan were several regulation changes which impacted general education and which would later help our efforts in the "New Liberal Arts:"

- Regulations were established for general education at our state colleges. These regulations marked, in a significant way, the end of the evolution from state teacher's colleges to undergraduate colleges of arts and sciences. They required a significant increase in the number of general education courses every state college student had to take regardless of major;
- New regulations also were established for general education at the community colleges. These required that there be a *balance* between various types of general education coursework for students in both career and transfer programs;
- Finally, in teacher education degree programs, we capped the number of professional education courses and required a major in a field other than teacher education. This led to more liberal arts and general education. In these teacher education regulations "technology" was specifically mentioned. In 1982 our Board said: "The inclusion of technology as an aspect of general education is intended to allow for the inclusion of courses and topics such as the history of technology and the sociological impact of technological advancement which would contribute to the general technical literacy of students." This was a major stride for those with an interest in "technology for all."

The framework was now set for an increase in the quality of liberal education and general education. The previously-mentioned quantitative changes opened up more opportunities for qualitative changes.

Everything was now positioned for positive change: issuance of a master plan reaffirming excellence; the Department's overall readiness to move toward more assistance to institutions; a new academic affairs structure at the Department; an "Education Governor"; legislative support; money; change in the state's method of developing its budget; an interest in science and technology; and regulation changes which enhanced the role of general education and the liberal arts.

Thus, the department began to act to provide increased technical assistance. In doing so it had in mind a general model as to how to stimulate curriculum change. The model has guided our attempts to play a leadership role in stimulating curriculum reform. Obviously, each of our specific curriculum-oriented efforts has seen the model being used in a slightly different way.

It consists of nine parts:

1. Notification to Presidents and Academic Vice Presidents of our interest in a particular curriculum area, discipline or project in order to alert them to our agenda and to gain their concurrence.

2. Direct outreach by the Department to faculty by directly hearing suggestions from those who deliver instruction and seeking help from them in planning.
3. Use of nationally-recognized experts to provide expertise the Department does not have.
4. The funding of at least one major "sensitivity raising" conference, designed to focus attention on a particular curriculum area.
5. A set of targeted curriculum development workshops or conferences, frequently discipline oriented, to provide follow-up to our "sensitivity raising" conference.
6. Use of faculty fellows in the Department, a program in which college faculty are released from their college duties to spend the academic year working on curriculum issues in the Department on a full-time basis.
7. Establishment of curriculum resource centers at individual colleges to aid curriculum development at all other colleges; for example, we have already funded three specialized "software centers" and one specialized "humanities resource" center.
8. Networking of faculty through advisory groups and computer conferencing.
9. Competitive grant programs which provide funding for proposals developed by faculty. These programs have been designed to utilize peer review panels made up of out-of-state faculty. The department fully accepts the peer panels' recommendations regarding which proposals should be funded. These grant programs bring primary and secondary benefits. The primary benefit is the specific activities that are funded and the objectives which are achieved. The secondary benefit is that the totality of our grant programs creates an atmosphere on many campuses which encourages thought, the formulation of curriculum change, and its implementation.

The nine steps appear to have worked well. The model has been carefully designed to reflect the sensitivities which arise when a Department like ours becomes involved in the area of curriculum development. We have deliberately sought maximum faculty input as the Department's expertise in any one academic discipline is bound to be less than that found on our campuses. We obviously could not implement change ourselves. Instead we had to play the role of a change agent — one who creates an environment and a set of activities which facilitate the work of others who have interest in planning and implementing change. In playing our catalytic role of stimulating curriculum change, we have taken advantage of certain characteristics of the Department which are widely acknowledged:

- The Department is acknowledged to be a good convener of all sectors of higher education in the state, thereby promoting dialogue, communication and planning;

- The Department is acknowledged as being a good disseminator of information about exemplary efforts across the state; and
- The Department is acknowledged as being a good vehicle for putting together programs which, if done by individual institutions, would not be cost-effective.

The Department used this nine-step model to foster change, not just relative to "The New Liberal Arts," but also other areas. To give you an idea of the range of curriculum areas we are involved in, let me list them for you. This is of particular importance because, however one defines "The New Liberal Arts," it cuts across traditional lines and touches upon other areas of interest to us. Further, our interest in "The New Liberal Arts" cannot be viewed in isolation from our other interests since our funding for what is defined as "The New Liberal Arts" comes from funding which flows to other areas.

Our funding is primarily received under what we label "Two Major Initiatives;" these being our Technology Initiative and our Humanities Initiative. Both benefit public and independent institutions.

The Technology Initiative consists of three significant programs:

- Our "Computers in Curricula" grant program which provides grants to integrate the use of computers into non-technical disciplines as appropriate.
- Our "Technical and Engineering Education" grant program which provides grants primarily to purchase state of the art equipment.
- Our "Math/Science/Computer Science Teaching" grant program which provides grants primarily for the enhancement of K-12 teaching and college teaching.

These programs, in operation since July 1, 1983, are now supplemented by a $90 million jobs, science and technology capital bond act, $33 million of which is designated for the enhancement of undergraduate technical, engineering and science instruction.

The Humanities Initiative consists of three programs:

- A large humanities grant program which provides grants to disciplines falling under the NEH's definition of the humanities.
- Two small, special grant programs, one for foreign languages and one for international education.

The approximately $12 million of funding which flows to the Department for grant programs is expended in three ways: 85 percent for competitive grants; 4 percent for administration; and 11 percent for what we label "central projects." "Central projects" are activities most likely run by an institution, sometimes by the Department, which are designed to benefit all our colleges or a group of colleges. When these central projects are run by an institution, the institution is not chosen by a competitive process but is chosen by the Department. Central project funds typically are the ones used for statewide conferences and resource centers, for example.

In addition to our two major initiatives in "Technology" and "Humanities," we have our most general and flexible grant program, "The Fund for the Improvement of Collegiate Education," and two other underlying areas of interest. They are: our

general interest in faculty enhancement; and our general interest in better understanding what demands the world of the future will place on graduates of our colleges. Faculty enhancement obviously takes its importance from the critical role of the faculty in quality education and is fostered by a wide variety of programs we sponsor; our interest in the world of the future takes its importance from our attempt to better understand what balance various degree programs ought to strike between technology and the humanities, and between general education and professionally-oriented courses. Understanding the future world of life and work commands constant Department attention, and will soon partially manifest itself in a business/humanities roundtable, designed to increase dialogue between New Jersey's corporate leadership and its academic leadership.

The full set of initiatives just described is one of which we are proud. In regard to our grant programs, we are particularly pleased that the people from outside of our state most knowledgeable about them, the members of our peer review panels, have honored us with comments as follows; about the Humanities grant program, a reviewer writes:

> "If New Jersey is not the envy of the nation for its support of the humanities, it should be. I know of no comparable program and I feel fortunate to have participated in it."

A review of our Computers in Curricula grant program writes:

> "I am so enthused by this program that I have written to [our] Governor . . . telling him about the fine work of the Computers in Curricula grant program and the New Jersey Department of Higher Education. Perhaps . . . [we] will someday have a similar program — and catch up with our sister state."

Further, we have been pleased with the reactions of our institutions, particularly the response of our faculty. In a recent paper on our grant programs, an American Council on Education fellow wrote:

> "In every sector, almost all agree that an unprecedented enthusiasm has been evoked from the faculty, which is not generally renowned for high spirits in the present academic world. There are numerous reports . . . that truly exciting projects have been generated by the Department's initiatives. There is widespread praise for the review process and the quality and objectivity of the consulting panelists."

Now to the specifics of what the Department has done to help foster "The New Liberal Arts." From what's been described, our interest should be obvious. If for no other reason, "The New Liberal Arts" can be thought of as a major tie between the "Technologies" which we support, and the "Humanities" which we support. Promulgating a definition of what we specifically intend to foster, however, has not been easy for us. Although the term "The New Liberal Arts" has clear meaning, there are those who argue that there are other worthwhile labels, other than "The New Liberal Arts," and other worthwhile definitions and approaches.

The Sloan Foundation deserves great praise for stimulating intellectual ferment, fc fostering the development of curriculum material, and for helping colleges implement curriculum change. Quoting from the Foundation's 1984 Annual Report, the aim of

"The New Liberal Arts Program" seems very broad in scope. As stated, it wants to foster ". . . the enrichment of the undergraduate curriculum in quantitative reasoning, in the application of mathematical analysis across many courses and disciplines and in the teaching of technology and the principles of engineering to liberal arts students."

It became rapidly clear to us, however, that some segment of the academic community in New Jersey viewed the expression "The New Liberal Arts" as only meaning the offering of a stand-alone course in engineering methodology. For that reason, we have avoided using the term "The New Liberal Arts."

We also avoided using the term for another reason. A Department like ours "defines" only at its peril when trying to facilitate curriculum change as opposed to establishing new regulations. "Defining" is for our institutions to do, or for the literature to do, or even for a foundation to do. A Department like ours must always be careful not to appear to be too prescriptive regarding curriculum matters. We have to foster our institutions' abilities to define and create, therefore, instead of using the term "The New Liberal Arts," we have focused in on two concepts: "Technological Literacy" and "Newness in Liberal Arts" *without defining them.* This has turned out to be wise, given various curriculum approaches which seem intellectually useful to us and to faculties across the state. These terms have encompassed and allowed us to foster at least three major approaches. The first suggests the incorporation of a separate course on technological developments and methodologies into a liberal arts core. The two other views are as follows: one holds that students should be technologically literate, not through a single course but by learning enough about methods underlying technology (such as mathematical modeling) in many liberal arts courses; the other view stresses the impact of technology on society, and an understanding of the impact of technology on public policy issues.

The Department sees the value of each of these views, and many variations. We did not want to decide what to implement, but instead wanted to help faculty think about various views, debate these views, and implement what they wanted to implement.

As an outgrowth of our interest in "Technological Literacy" and "Newness in the Liberal Arts," we have also stressed the integration of the computer in liberal arts disciplines as appropriate. In regard to the use of computers, we have not focused on "computer literacy" (which can be labeled as a minimal understanding of what computers are and what they can do) but have focused instead on what we label "computer proficiency," — the use of the computer as a tool in understanding a discipline, and in doing scholarly work and research in that discipline.

Now let me list specifically what the Department has done to foster "Technological Literacy" and "Newness in Liberal Arts":

We talked to key faculty members in New Jersey, we talked to people elsewhere, we convened an *ad hoc* technological literacy group, and we began to include material on the importance of "technological literacy" in various Department documents;

We received the staff support we needed from an excellent faculty fellow, who undertook bibliographic research, and who began to plan several conferences which have had and are continuing to have far-reaching effects;

We began with a one-day overview conference on the nature of technological literacy last December. Speakers at this conference (which was attended by faculty, administrators and college presidents) included John Truxal from SUNY Stony Brook and the President of the Sloan Foundation.

This introductory, "sensitivity-raising" conference was followed by seminars on the links between technology and specific liberal arts disciplines. In March of this year, we sponsored a one-day seminar for history faculty on the historian's response to "The New Liberal Arts" movement. The main speaker was Steven Goldman, Director of the Science, Technology and Society Program at Lehigh University. This seminar provided opportunities to express other definitions of "The New Liberal Arts." Other speakers came from SUNY Stony Brook and Roosevelt University.

At about this time, the Department also held a seminar featuring members of the Department of Engineering and Public Policy at Carnegie-Mellon University. All of the engineering schools in New Jersey were represented at the meeting. The discussion focused on the Ph.D. program at Carnegie-Mellon which is designed for persons wishing to link engineering expertise with public policy development. Our aim was to stimulate thinking about the wisdom of offering such a program in New Jersey.

In May, we sponsored another seminar for faculty in art and art history. This was also attended by faculty in physics and engineering. It dealt with the insertion of technological topics (particularly the study of large-scale engineering works) into the art of science curriculum. The seminar was led by David Billington of Princeton. Scientists found structural analysis to be an innovative approach to student exploration of materials, stresses and internal forces. Artists and art historians enhanced their appreciation of the relationship between efficiency and aesthetic excellence.

This October, the Department is sponsoring a conference on "Technology and Political Thinking," which will explore how technology affects the way we define political concepts, such as power, authority, participation, and civil liberties. Speakers will include experts from Yale University, New York University and the United States Office of Technology Assessment.

This spring, the Department will sponsor three additional seminars exploring the link between technology and the disciplines of sociology, philosophy and music.

The overview conference and the discipline-oriented follow-up seminars represent Phase 1 of the Department's "Technological Literacy" initiative. We have already, in parallel, begun Phase 2, which concentrates on bringing these ideas directly into the classroom. Phase 2 consists of intensive workshops and our grant programs.

In June, we sponsored a nine-day workshop on Technological Literacy curriculum development. Nine institutions from all sectors of higher education in our state were represented by teams of four faculty; each team had to include both "technologists" and "liberal arts" faculty. Participants were exposed to models used at various non-New Jersey institutions including SUNY Stony Brook, Iona University and Brown University. Under the leadership of John Truxal of SUNY Stony Brook, faculty focused on which elements of technology could be learned by general undergraduate students, and how this material could best be presented within constraints existing at the specific institutions represented by the teams. Teams were required to develop plans for a specific curriculum change on their campuses. The plans for curriculum change, which are being refined this semester, range widely. On some of the nine campuses the team of faculty has widened into a Technological Literacy Task Force in an attempt to implement core curriculum change; on other campuses curriculum changes have already been implemented. Further, the entire group is holding follow-up meetings and discussions on how to promote technological literacy. One of the outcomes of those discussions is that planning has begun for a computer conferencing network with funds for its support already allocated by the Department. The Department has

scheduled this same type of intensive workshop to be repeated this coming January and held again next June.

In addition to conferences and workshops directly dealing with "Technological Literacy," let me mention a set of conferences and workshops which we categorize as ones dealing with the integration of computers into various disciplines. These activities are related to the concept of "Newness in Liberal Arts." Separate conferences have dealt with the following disciplines or groups of disciplines: Journalism; English, Foreign Languages; the Humanities; and the Social Sciences. Further, intensive 10-day summer workshops were offered for faculty interested in "Computers and Writing" and in "Information Age Technology and Communication."

Phase 2 also involved our grant programs. Several projects funded under our grant program in humanities — our "Computers in Curricula" Grant Program and our Math/Science/Computer Science Grant Program — have advanced the cause of "Technological Literacy" and "Newness in Liberal Arts."

As an example, our Humanities Grant Program funded a proposal which ". . . explores the nature of the relationship between the arts and technological change";

Another grant funded a proposal ". . . to create two new courses . . . to study gender, technology, and social values . . . and expose humanities majors to new technologies which raise questions about cultural responses to change";

Another grant funded a proposal to ". . . explore important technical systems . . . from the viewpoint of the cultural historian";

Another funded a faculty development effort at one college which was designed to ". . . illuminate, from different disciplinary perspectives, the cultural and social dimensions of technological change."

Examples from our Computers in Curricula Grant Program also can be cited; examples which deal with projects in non-science, non-technology disciplines.

A project was funded ". . . to provide . . . a deeper understanding of . . . human musical behavior through computer modeling, simulation, analysis and synthesis . . ."

Another project was funded in which ". . . computer modeling and simulation will be used to advance critical thinking and decision making." Another project calls for ". . . the use of sophisticated simulation . . . models . . . ."

Let me cite two examples from our Math/Science/Computer Science Grant Program. One proposal for ESL students stated: "General technological concepts and career awareness will be integrated while improving the students' language, critical and problem-solving skills." The second stated: ". . . limited English proficiency has acted as an impediment which has prevented our Hispanic population from pursuing studies . . . in science and technology. They have therefore been left defenseless against the demands of life in a competitive, technologically oriented society . . . ."

We are planning many more activities — some of which will take place under the rubric of a forthcoming new statewide faculty and staff enhancement initiative which we are planning. Let me quote from our Board's budget recommendations to the Governor for fiscal year 1987. The faculty enhancement effort ". . . is designed in part to bring new or developing fields, such as technological literacy, to the attention of New Jersey faculty and administrators . . . ." This faculty enhancement effort will increase opportunities for faculty to explore "Technological Literacy" and "Newness in Liberal Arts." Further, we are hopeful that more grant proposals in these areas will be forthcoming, as more faculty consider implementing new courses and changes within courses.

As for the Department, we are actively considering the following:

- More nine-day intensive workshops;
- More discipline-oriented seminars;
- A resource center to house "Technological Literacy" curriculum material including films, videotapes and exhibits;
- Summer seminars in which faculty, working with students in Liberal Arts honors programs, would explore technological issues from the perspective of their disciplines; and
- A graduate level program for Liberal Arts faculty already possessing a doctorate, who would like to expand their understanding of the substance, uses, methodology, and impact of technology. This graduate-level program might be similar in structure to a master's degree program we have supported which has allowed faculty members with Ph.D.s in mathematics and the sciences to earn a master's degree in computer science through 15 months of close to full-time study.

Our aim, as we look to the future, is to achieve a "critical mass" of efforts and activities so that "Technological Literacy" and "Newness in Liberal Arts" is fostered much more by the spontaneous efforts of others than it is by the Department and Department-funded activities. We would be delighted if change gathered a momentum of its own; if it became "out of control" from the perspective that most statewide activities got under way without our facilitating them.

Having described our effort for you, it might be useful to ask: "What lessons might one learn from our overall curriculum stimulation role and our attention to "Technological Literacy" and "Newness in Liberal Arts?"

First and foremost, the lesson learned is that the state can play a role — our nine-step model has worked for us. In our view, the state-funded faculty enhancement experiences and the competitive grant programs have stimulated considerable campus activity, and have made a real contribution toward strengthening the quality of undergraduate curricula. Much is happening which would not have happened if only institutional budgets had increased. We even hear of good projects (which we could not fund because we did not have enough money) being implemented on campus without our support.

Part of what has occurred has taken place because the Department has gotten extra money which flows to benefit colleges in targeted ways; but, perhaps even more important, an overall change in attitude has occurred. There is now a widespread belief among members of our higher education community that progress toward excellence is more possible than ever — there is an increased excitement.

There is another essential lesson and that is: traditional advocacy worked. A part of our catalytic role has included active advocacy for funds for our initiatives. We took our case to all forums — Legislators, legislative staff, Governor's budget people — persons for whom, for example, "Technological Literacy" and "Newness in Liberal Arts" were not the most significant issues until they were helped to fully understand them and their importance. References to "Technological Literacy" and "Newness in Liberal Arts" were time and time again placed in a variety of significant Board and Department of Higher Education documents.

As examples, a December 1983 document entitled *Proposal for a Bold Initiative in Higher Education*, submitted to our Governor and his staff, asked for support so we could, among other goals: ". . . insure the technological literacy of all students . . . ." Further, it stated: ". . . all graduates must acquire an understanding of the importance of technology to their lives . . . ." Our Board's FY 86 budget recommendation to the Governor submitted in October 1984 stated, "Art, English, Social Science, and other Liberal Arts students must understand technological principles in order to participate intelligently in our society, where technology is a critical factor in many public decisions. The purpose is to encourage the adoption of a technological perspective in New Jersey undergraduate curricula."

Our document, entitled: *Bold Initiatives in Higher Education: The Second Year*, written in November, 1984, spoke about the need for ". . . a population which is technologically literate . . . ."

These statements became powerful references as a host of face to face meetings took place. Further, these types of statements were critical as we sought and received press coverage about our initiatives.

In the Department's advocacy for the initiatives, help came from strong, supportive, well-informed presidential and faculty leaders who included these programs in their overall lobbying efforts. This was obviously important.

We also learned that it was wise to use "the weight of authority approach." Bringing in people from outside the state (not only to gain their input, but also their validation of ideas we had or conclusions we had reached) was most useful. Further, their dialogue with in-state faculty helped convey that the Department had no hidden agenda regarding curriculum development other than to foster faculty thought and action. Throughout the planning of our entire "technology initiative," we were most fortunate to have had the wise counsel of an exceptionally knowledgeable lead consultant, John Truxal of SUNY Stony Brook. He guided us well, and New Jersey is clearly in his debt.

If one asks if we have carried out our curriculum stimulation role in perfect fashion, of course the answer is no. If we could start from scratch, there are things we would have done differently.

We would have emphasized more dissemination of what we've supported on individual campuses to other campuses throughout the state; we would have supported more evaluation in order to identify highly successful projects; we would have provided more technical assistance to individual colleges whose faculties have been less than successful in securing grants; and we would have created a better set of specific lobbies and networks in support of each of our grant and other programs. This would be particularly useful in regard to "Technological Literacy" and "Newness in Liberal Arts" which, in New Jersey, have no well-defined and organized lobby. Our overall model has served us well; marginal changes could improve its effectiveness.

As we look into the future what do we see regarding "Technological Literacy" and "Newness in the Liberal Arts?"

In my judgment, there are certain factors which will make "Technological Literacy" and "Newness in Liberal Arts" even more important than they are today:

- The first factor is "demographics." We know we can expect relatively more high school graduates coming to us from urban school districts than suburban ones. We know that urban districts typically send us more underprepared students. Despite improve-

ments which are occurring, many students not only will come to us with deficits in reading, writing and computation, but will also most likely lack knowledge of technology, technological methodology and how technology impacts society;

- The second factor is "technology" itself. Its pace of change will only increase, making it more and more difficult to understand what it is and how it will affect us;
- The third factor is "the world of work." It will be dramatically impacted by demographics and technology. New structures will emerge and new skills will become needed;
- The fourth factor is "life." Existence will only be more complex with critical thinking skills and the ability to clarify values more needed than ever, in order to understand public policy issues.

Demographics, technology, work, and life, all will make our efforts at curriculum development more difficult as we match the current and future needs of students with an appropriate array of degree programs and courses. And clearly, in my opinion, "Technological Literacy" and "Newness in Liberal Arts" will assume even greater significance.

Let me now conclude.

I have attempted to sketch the context within which curriculum change in higher education in New Jersey has been undertaken. I also have mentioned some program initiatives and outcomes, as well as some lessons learned.

I hope as you review your higher education scene and your needs, some of our experiences and approaches can be adapted for your use. To end by listing the most critical keys to our success, they are: Our Department's shift from regulation to serving as a catalyst; input directly from faculty and out-of-state consultants in shaping our Department's efforts; lobbying; faculty development programs; and a direct challenge to faculty creativity through competitive grant programs.

Thank you for your attention. I wish you well in your initiatives.

At this point, I will be glad to answer any questions.

New Liberal Arts

by

Thomas E. Kurtz

Traditionally, the liberal arts have encompassed all that knowledge which is not technical or vocational in nature. This includes the humanities, the fine arts, and the social sciences. Such knowledge provides us with a better way of life; it broadens our perspective of the world and increases our ability to comprehend and react to a wide range of life experiences. One could almost characterize the traditional liberal arts as the purest form of hedonism, since they — art, history, abstract ideas — are fun as well as intellectually stimulating. Many critics, however, have long viewed the old liberal arts as an esoteric and impractical body of knowledge that has no direct application to today's rapidly changing technology-based work world. The concept of the "new" liberal arts integrates the seemingly hedonistic knowledge of the old liberal arts with the "pragmatic" knowledge of science and technology, since today it is important to be able to *do* something (technology) as well as to know something (humanities).

The distinction between practical skills and "hedonistic" knowledge is not as clear as it may at first appear, nor is the integration of the two bodies of knowledge as great an undertaking as one may think. Writing and speaking are skills, the ability to *do* something, just as computer programming or engineering are skills. Similarly, our quality of life is enhanced as much by knowledge of abstract mathematics and the wonderful ideas of physics and astronomy as it is by knowledge of history or art. As one of the most respected computer scientists of our time, Alan Perlis of Yale University, once said, "the true humanistic subjects are engineering — it gives us a better life; medicine — it helps us live to enjoy life; and law — it helps us to adjudicate our disagreements." Liberal arts courses, which have long been labeled "esoteric" and indulgent, are exceedingly practical and necessary for functioning in the present day world. Foreign languages, for instance, are not useless ivory tower subjects, but are fundamental to our survival, especially for those who are involved in business, politics, and the rapidly changing realm of the sciences. Consider, too, the large number of people, especially those in power, like politicians and corporate and academic administrators, who make their living in large measure by writing and speaking. Thus, it appears that the ultimate vocational course in our liberal arts curriculum is not computer programming but expository writing. Likewise, while mathematics and computing are essential to our economy and future, and are valuable skills for anyone entering the workforce, they are also intensely "liberating" arts: we should teach them not only because they have some vocational content, but more importantly because they embrace fascinating intellectual ideas.

Unfortunately, many students avoid all quantitative subjects because they claim that they are "not very good at math," or perhaps because they are just too lazy. Stu-

dents in technical subjects often have no problem with history or other traditional "liberal" arts. Why is it that we allow our nontechnical students to so easily avoid all of the wonders and beauties of mathematics, physics, biology, and the other sciences? Is it inevitable that our leaders will end up as lawyers *because* they wish to avoid quantitative subjects such as science and math? Koerner, an authority on computer use and the new liberal arts, deems the computer "an instrument of unparalleled power for instruction in quantitative reasoning, (which) lies at the center of the new liberal arts program, is not an end in itself but is an omnipresent learning tool, like a library."

The computer can, and at some institutions does, serve as a unifying force between the traditional liberal arts and the quantitative subjects. At Dartmouth, for example, students do use computers as frequently as they use the library, and there are no faculty committees and no philosophical discussions to hamper this use. Over the past 20 years the computer has become universal at Dartmouth. Everyone on campus has a user account — faculty, students, and all staff members. There are at least 1000 terminals on a campus that has 4000 undergraduates, 800 graduate students, and nearly 1500 employees. Actually, there is no way to determine accurately the true number of terminals existing on campus — no one really cares about the number since computers are as omnipresent as typewriters, and who would care how many typewriters are on a campus?

At Dartmouth, computers are used to perform numerous functions. Student word processing is commonplace. Other uses include communications (i.e. computer mail), library access (students will shortly have direct access to the online library catalog through their personal computers) and all kinds of classroom use. It is difficult to talk about the computer at Dartmouth, for it is endemic to the school. Although its presence on campus is firmly established, its functions are always changing. Currently, a Local Area Network (LAN) is nearing completion. It will provide outlets in literally every classroom, every office, and every dorm room. The LAN will connect to a bevy of central machines of all types. Two of them are large Honeywell machines that run the Dartmouth DTSS time sharing system. There are also VAXs and other types of machines connected to the LAN. Additionally, the LAN is hardwired to outside networks such as Telenet and Tymenet. A person having SOURCE or DOW JONES accounts can connect to them from an office or dorm terminal without having to make a long distance call.

Currently, all Dartmouth freshman own their own machines. For now the machine is an Apple MacIntosh. In four years, there should be nearly 5000 personal computers around campus, all with graphical capability. It is difficult to see four years into the future and predict how these personal computers will be used. However, at the present time the existence of online access to the library catalog system is assured. Presently, 40 percent of the library's holdings are online. Direct access into various bibliographical network services will also be provided within the next four years. Word processing will expand across the campus since better output devices will become available to the students. Courses within every discipline will increase their use of computing, whether on a big machine through the network or on a personal computer through a diskette. Additionally, with the increased number of computer terminals which will exist on the Dartmouth campus within the next four years, students will be able to program a variety of machines — MACs, IBM PCs, large machines — in the same language.

Far from discouraging participation in and exploration of the traditional liberal arts, the computer encourages inquiry into such subjects. Ideally, both students and

faculty should be computer literate — they should be able to both use and understand computers. The computer, according to Koerner, "happens to constitute an excellent technological topic in itself, a universally accepted technology that might be studied in the new liberal arts colleges as one of the fundamental artifacts of the age." The truly important purpose for incorporating computer use into the liberal arts curriculum is that it models a way of thinking that is every bit as fundamental as high school algebra. Both are abstract ideas which possess great power and beauty. Knowledge of both the practical application of computers and the theory behind them allows one to take control of the learning process, incorporating both skills and theory.

Computer use and computer skills must be incorporated into the liberal arts program without losing sight of the importance and purpose of the old liberal arts. Teaching students to become computer literate does not mean that they should possess a body of knowledge which encompasses all facets of computer use and application — jobs, social impact, etc. Such a definition of computer literacy means virtually nothing, since it refers to a body of knowledge which would take years to accrue. Would we ever dream of offering a course entitled "the social impact of the automobile," with the magnitude of knowledge it would presume to encompass? Moreover, students should not be led to believe that if they know a little bit about computing they can get a good job. The computer vocational euphoria that has swept the country in the past few years can't last. It has been estimated that our society needs, per year, only about 30,000 programmers, while at the same time around 200,000 will find employment as fast food servers and 300,000 as janitors. Of those students now in high school, not more than one or two out of a hundred will get a job as a programmer. Training students to be COBOL programmers is shortsighted. Even if we concentrate on FOCUS and other so-called fourth generation computer languages, few students will be able to earn their living purely as programmers.

The extraordinary growth of computer chips and other computer devices is allowing institutions to bring quantitative ideas into the liberal arts curriculum. As educators, we must meld computer skills with other "vocational" skills, such as writing and speaking, which have long been associated with the liberal arts. We must combine the beauty of quantitative theory with the other, more traditional forms of "liberating" knowledge. Computers can bring new life to wonderful ideas, and that's the purpose of the new liberal arts.

A New Liberal Arts Course on Decision Analysis

by

Samuel Goldberg

Detailed below is an outline of a presentation offered at the June 1984 Albany New Liberal Arts Conference by Dr. Samuel Goldberg, Program Officer of the Alfred P. Sloan Foundation, and at the time of the conference, a professor of mathematics at Oberlin College.

Dr. Goldberg's talk focused upon decision analysis through discussion of an Oberlin course entitled Introduction to Decision Analysis, and provided illustrative examples of decision problems to introduce the concepts of model building, conditional probability and joint frequency tables, utility and risk aversion and sensitivity analysis.

Outline of Talk Given at Albany Conference

A course, *Introduction to Decision Analysis*, offered for a number of years at Oberlin College, was described. It is intended for beginning students with no prior college work in mathematics and only little experience with algebra.

The following illustrative examples of decision problems were discussed:

- A production manager must decide whether to incur the cost of inspecting a manufactured product with an imperfect testing device or to ship it without inspection and risk customer dissatisfaction and the added cost of repair if the product turns out to be defective.
- A company executive must decide whether to settle a patent infringement suit out of court or to keep the lawyers working and face the uncertainty of a jury trial.
- A physician, when presented with a patient with standard appendicitis symptoms, must decide whether to operate right away or to wait in the hope that surgery will prove unnecessary, but thereby risking a ruptured appendix and associated complications.
- A 37-year-old pregnant woman, concerned about carrying a Down's syndrome fetus, must decide whether or not to undergo amniocentesis.

These examples were used to introduce the ideas of model building, conditional probability and joint frequency tables, utility and risk aversion, and sensitivity analysis. The use of personal computers for carrying out a decision analysis was illustrated.

Among the points made in passing were: (1) the importance of introducing prob-

lems in English prose and thus requiring students to construct a suitable decision tree; and (2) the crucial role of getting and maintaining student interest, of presenting mathematics in the context of interesting applied problems, and of offering readings and references from the literature of business, the social sciences and medicine.

The Impact of Technology on Art and Art on Technology: A College Course Design

by

Julie H. Wosk

When I first came to SUNY Maritime College — a college specializing in maritime engineering, science, and business located on the eastern edge of the Bronx on Long Island Sound — I saw that the Department of Humanities and the Science and Engineering buildings were at opposite ends of the campus. In fact, the humanists and technologists seemed to have little in common. The campus itself was intersected by the looming Throg's Neck Bridge, which further divided what C.P. Snow has called the "Two Cultures."

It seemed clear to me that one of my tasks as an art educator was to help close the gap between art and technology — two realms that are often considered opposed to each other. Artists are said to cherish spontaneity, personal expression, lack of boundaries, while technologists value order, impersonal objectivity, and the bounds of rationality. Yet a college course on Art and Technology, if carefully structured, could go far to illuminate areas where the "Two Cultures" profitably interact and have a beneficial impact on each other.

The course I ultimately designed looks first at the impact of new technologies on architecture, design, and the fine arts. New technologies have provided new materials — including plastics, steel, concrete, neon, electronics, lasers, video — and new structural techniques which have dramatically altered the appearance of both art and design. Modern technology has also provided a machine aesthetic which, in the guise of Modernism, has until recently dominated twentieth-century design.

The course also focuses on the impact of art on technology. Artists and designers have sought to tame technology, making it more humane and less destructive. Artists have designed more humane housing, and provided postmodern alternatives to the impersonal machine aesthetic of the international style. Artists have presented vivid pictorial and sculptural images of technology's social impact during the past two centuries. Their works have shown admiring as well as alarming perspectives on the machines that have shaped our urban environments and psyches as well. Recent art focuses on ways to accommodate technology while also further humanizing it. Cybernetic sculptures, as an example, represent sculptural machines that respond with sensitivity to human viewers.

The purpose of the course on Art and Technology is twofold: it increases students' awareness of how technology has shaped the style and content of art, and it reveals the ways artists have sought to transform technology and explore its creative potential. Students also gain technological literacy — they become more conscious of the social

and ethical implications of modern technology. They can begin to take a more informed view of their own research and technological decision-making.

The first major course topic is the impact of new industrial materials such as steel and reinforced concrete on modern design and building structure. The evolution of skyscraper design is traced from Louis Sullivan's "Form Follows Function" dictum of the Wainwright Building, St. Louis (1890) through the glass-and-steel austerity of The Bauhaus (1929), Modernist Mies van der Rohe's and Philip Johnson's Seagram Building (1958), and more recent examples including Edward Larrabee Barne's IBM Building in New York and the Xerox Building in Chicago. The uses of molded concrete to create biomorphic, expressive forms are seen in the structures of Le Corbusier and Saarinen. The efficiency of concrete is found in Le Corbusier's public housing structures — his "Machines for Living." More recently, fiberglass and Teflon have provided new possibilities for lightweight tent structures used as giant sports stadiums and shopping centers.

Not only has industry provided new materials for artists and designers, but it also provided the inspiration for the machine aesthetic. The course traces efforts by architects and designers to find a style for an industrialized society. During the nineteenth-century, industrial designers and architects often insisted on maintaining a traditional, historicized aesthetic, even while using new industrial materials and structural techniques. Newly-designed factory beam engines of the 1840s were often encased in cast iron frames, decorated somewhat incongruously with Classical Doric columns or Gothic arches. New machine-made cast iron furniture was covered with ornate rococo decoration. Though Louis Sullivan utilized new steel-frame construction in building the Wainwright Building, he covered the new technology with heavy masonry and ornate decoration. By continuing to use historical forms, designers attempted to keep a sense of continuity, order, and dignity amidst rapid industrialization and technological changes.

Increasingly, though, early twentieth-century designers began to emulate the spare, clean, unornamented designs of modern industry and machines, as seen in the industrial products of the German Werkbund and the Bauhaus. Today's High Tech and Soft Tech designs continue the machine aesthetic, as do the Late Modern buildings of architects Richard Meier and Japan's Arata Isozaki with their use of concrete forms and gleaming machine-like facades.

Today's postmodern architects and designers tend to reject the modernist machine aesthetic. They seek to humanize technology and alleviate the sterile look of Modernism. The course considers the work of architects Robert Venturi, Michael Graves, Charles Moore and others who have resisted the machine aesthetic of international style architecture, which they criticize as cold and cut off from its historic roots. Postmodernists have urged a return to historical ornament, made playful, ironic references to past styles, and paid tribute to pop culture as a way to make architecture more humane. Philip Johnson's A.T. and T. building alludes to Brunelleschi's Renaissance Pazzi Chapel and American Chippendale Furniture. Charles Moore's Piazza d'Italia in New Orleans (1978) makes witty uses of classical design and modern technology. Ionic order columns have capitals with stainless steel volutes, and a new "Delicatessen Order" is outlined with neon lights.

Today's product designers are also attempting to humanize or domesticate new technologies: oversized home video screens and personal computer equipment are incorporated into earth-tone home settings; postmodern furniture by Robert Venturi and

the Memphis designers in Milan turn chairs into historical parodies or playful geometric Pop Art sculptures; plumbing manufacturers are humanizing their austere, industrially-produced bathroom fixtures, placing them in settings with such fanciful names as "Heritage Retreat" where porcelain tubs are encased in knotty pine and endowed with "colonial charm."

Technology has also had a major impact on the fine arts, providing new imagery and new media for creative projects. Twentieth-century sculptors have explored the uses of a wide range of materials. Duane Hanson's polyester resin and fiberglass figures such as *Tourists* (1970) have an uncanny and disconcerting *trompe l'oeil* reality. Neon lights have shaped the sculptures of Don Flavin and been transformed by Cryssa in *Ampersand* into a flashing, repetitive satire of mass-culture's duplications. Laser beams directed towards the sky have allowed New York's Daniel Infante to "write" colored images on clouds. Stainless steel and welded industrial metals have provided a rugged new sculptural idiom for sculptors such as David Smith and Anthony Caro. Electronic motors have given artists the means to propel kinetic sculptures, and have been put to imaginative use in drawing on solar energy for power. For example, *Primogenesis*, by sculptors Williams Severson and Saunders Schulz, is a 25 foot stainless steel sculpture which transforms solar energy into electricity, which helps rotate the massive sculpture in the sunlight.

Electronic equipment has helped extend the boundaries of art in other exciting and challenging ways. New Wave performance artist Laurie Anderson relies on electronic sound equipment, including harmonizers and amplifiers, to turn her body into an instrument: her voice is strangely lowered and multiplied, and her head tapped to create unearthly tones. Anderson's use of technology — including telephone answering machines, video imagery, and computer print-outs — inform her ironic commentaries on the ways technology molds and filters our experiences, alters our perceptions, blocks and extends our ability to communicate and make contact.

Video, film, and computer-generated graphics have also provided new materials and tools for artists' commentaries on technology. The video experiments of Nam June Paik and Stan Vanderbeek provide witty and surreal views of our contemporary cultural environment. Using computers creatively, computer artists David Whitney and Nancy Burson, among others, have fused computer and photographic images, creating odd hybrids and new variations on the human image.

Technology has also prompted a shift in art iconography as artists have weighed the impact of industrialization and machines on the human psyche and society. The course looks closely at the wide range of artists' responses to technology — responses which have included admiration, anxiety, optimism and despair. Artists at the beginning of the industrial revolution showed fears of factory explosions (cf. *Explosion and Fire at Shiffna* (1821), yet by the end of the century their art reflected the country's explosive excitement at the new technological marvels. A contemporary print showing the inauguration of the Brooklyn Bridge (1883) emphasizes the thrill at engineering expertise, as the bridge is illuminated by bright lights and the explosions of celebratory firecrackers.

Yet artists' anxieties about explosive machines were never quelled. Satirizing the deadly capabilities of the nuclear bomb, Jean Tinguely on March 17, 1960 set in motion his sculpture *Homage to New York (Self-Destroying Machine)* in the courtyard of New York's Museum of Modern Art. After running for 30 minutes, the sculpture made of rusty old machine parts, an addressograph and a piano, set itself on fire with

gasoline, a fitting emblem of a technological death wish.

Other artists have shown the exciting achievements of the machine age. Relishing the "dynamism" of speeding automobiles, the Italian Futurists at the beginning of this century painted abstracted, overlapping images of the automobile moving forward in time and space. In their bright abstract canvases filled with swirling synchronous colors, French artists Robert and Sonia Delaunay delighted in the dazzle of electric lights, whirling airplane propellers, and magnificent feats of modern engineering such as the Eiffel Tower. America's Joseph Stella, in his geometric abstractions, championed the Brooklyn Bridge as a national icon, lending a worshipful, religious aura to the structure. Precisionist painters Charles Sheeler and Charles Demuth represented industrial structures as pristine monuments in a timeless, immaculate industrial landscape (cf. *Rolling Power).*

Yet artists have also feared that technology not only expands human capabilities but also has a dehumanizing impact. Honore Daumier's nineteenth-century lithographs satirized the trials of railroad travel where hapless riders were seen being jostled and thrown into the air. Sick passengers were told to wait, for the rushing train stopped for no one.

During the twentieth century, French artist Fernand Leger presented good-humored paintings of machine-like tubular human figures painted metallic grey, yet other artists took a dim view of the prospect of mechanized humans. German artist George Grosz, in an untitled 1920 work, painted mass industrial man as a solitary human figure — faceless and armless — standing anonymously near factory buildings, his identity lost amidst depersonalizing machines. Ernest Trova's polished chrome sculptures — his faceless cyborgs of the 1960s — are attached to automobile wheels and pacemakers, reflecting our increasing dependence on supposedly servant machines.

Twentieth-century artists have focused on modern technologies which not only dehumanize us but are also cruelly aimed at destroying humanity. Their paintings decry the malevolent military uses of war machines and the numbing psychological effects of using sophisticated weaponry. Picasso's celebrated painting *Guernica* (1937), with its stark black, white and grey angular geometries and screaming faces of victims, represented the artist's anguished protest against a German air bombing of Spanish civilians. Thirty years later, the pop art of Roy Lichtenstein charted with cool irony the dangers of modern military aircraft. Lichtenstein's painting *Whaam!* (1963) took a sardonic look at the way technology deadens consciousness, producing pilots who are detached from their act of killing. Two enlarged cartoon panels show a flyer hitting a target while the word "Whaam!" appears in splashy color, reducing the fact of death and destruction to a flattened, two-dimensional, neutral splat. The comic strip pilot's words suggest he sees High Tech killing as a glamorous adventure: "I pressed the fire control . . . and ahead of me rockets blazed through the sky."

The two perspectives of the life-enhancing and life-destroying aspects of modern technology have appeared in art throughout the twentieth century. Increasingly, artists are warning of an apocalyptic nuclear catastrophe; the extreme example of technology's threat to humanity. Yet, although artists have presented dramatic images of technology's tendency to dehumanize man and create emotional lives that are cold and mechanized, art of this century has also offered avenues for coming to terms with the machine. The course concludes by considering ways artists have attempted to humanize technology through creative collaborations between artists and engineers. Cybernetic or feedback sculptures represent a new breed of art aimed at producing sculptural

machines that are sensitive to the natural and human environment. Using small electronic motors, computers, and sensoring devices, these works are designed to respond to human touch, proximity and sound. While artists have charted the ways technology can numb human sensitivities, the creators of cybernetic sculptures are intent on helping participants increase their ability to feel and perceive. Viewers coming in contact with these sculptures may experience an increased self-awareness and a heightened sense of their own individuality. In this respect, cybernetic sculptures not only humanize machines but spectators too.

A wide variety of viewer-responsive sculptures have been produced, beginning with a burst of creative experimentation in the 1960s and 1970s. At M.I.T.s Center of Advanced Visual Studies, artists such as Alexanjo Sima have created *Touch Bulb* (1976), a glass bulb filled with electrically charged neon and argon gases that create mesmerizing kinetic light patterns when touched. *Heart Beats Dust* (1968), by artist Jean Dupuy and engineer Ralph Martel, was an award-winning cybernetic sculpture in a competition sponsored by Experiments in Art and Technology, and New York's Museum of Modern Art for MOMA's exhibition, "The Machine," held in 1968. Dust particles enclosed in a glass cube were activated by the acoustic vibrations produced by amplifying the sound of a participant's heart beat. A high intensity light beam shining into the cube's interior illuminated the resulting patterns of particles, providing a very intimate and creative connection between the human body and technology.

Other cybernetic mixed-media works have helped transform participants into modest musical composers and video stars. Liz Phillips' installation, *Sunspots* (1981), exhibited at the Neuberger Museum's Soundings Show, used a stereo amplifier, loudspeakers, and light sensors to generate a unique sound environment. As spectators moved into the room, their actions produced a random series of musical tones, creating a one-of-a-kind sound sculpture. Les Levine's *Contact* (1969) invited participants to stand in front of a series of video monitors encased in a large sculptural box. Reflecting on their own video images in a variety of monochromatic colors, viewers experienced a heightened sense of self-awareness as they themselves were transformed by technology into works of art.

Examining cybernetic sculptures and the wide range of art works reflecting the impact of technology, students in the course ultimately come to recognize that modern technologies have the potential to diminish as well as to heighten our humanity. Today's art continues to present forceful images of foreboding and hope. Artists vehemently denounce the possibility of technological catastrophe, yet also devote their creative energies to converting our destructive technologies into more life-affirming impulses. The effort to tame technology through art goes on.

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SUNY Meetings on the New Liberal Arts

Date	Place	Theme
June 4-5, 1984	State University at Albany	Science Technology and the "New Liberal Arts": A Colloquium
November 9-10, 1984	SUNY College at Potsdam	North Country Workshop on Science, Technology and the Undergraduate Curriculum
March 21-22, 1985	SUNY College at Fredonia	Western New York Workshop on Science and Technology in the New Liberal Arts
April 12, 1985	SUNY College at Cortland	Science, Society and General Education for the Eighties and Beyond
June 12-14, 1985	State University at Albany	Decision Theory, System Analysis, and the New Liberal Arts
September 27-28, 1985	State University at Buffalo	An Action Plan for the New Liberal Arts